Aviation Week

Including Space Technology

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A McGraw-Hill Publication

September 22, 1958

Gulfstream Aims At Long Life, Reliability

Black Knight Design Detail

(page 50)



Saunders-Roe Black Knight

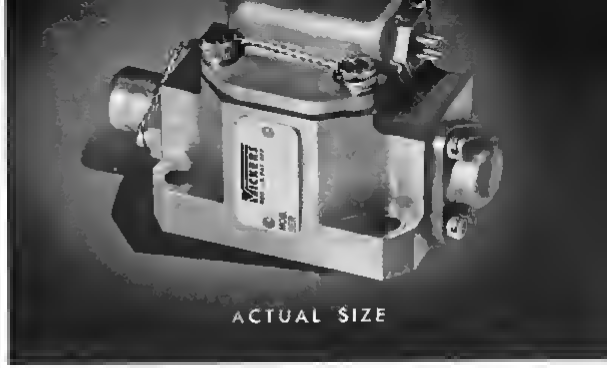


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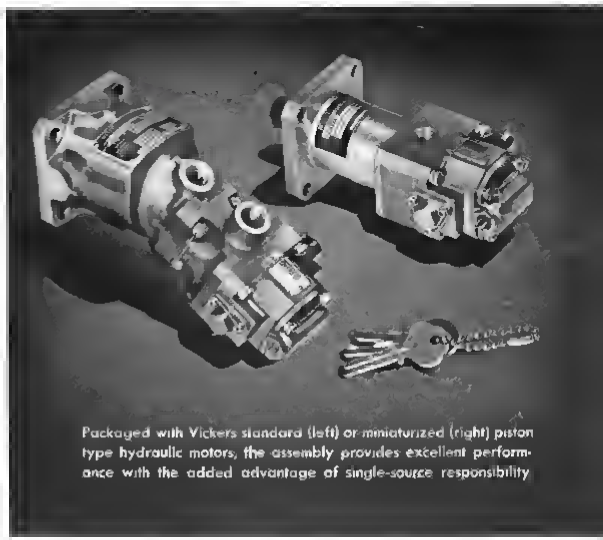
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Porting modulated flow to linear or rotary actuators with respect to minute input current has been optimized within a small envelope and at a weight that is approximately 30% less than other valves of similar capacity. Design also provides for interchangeability with many existing servo valves now used in airborne applications. For further information, ask for technical bulletin number SE-98.



Packaged with Vickers standard (left) or miniaturized (right) piston type hydraulic motors, the assembly provides excellent performance with the added advantage of single-source responsibility.

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NEW ELECTRONIC HEAT RATE COMPUTER HELPS SLICE THROUGH AIRCRAFT "HEAT WALL"

This latest General Electric Computer helps simulate aerodynamic heating encountered in flight by high speed aircraft. Compression of air around an airframe increases air temperature. The temperature rise can be calculated from wind tunnel test data taken from scale models. Stresses created by artificially heating actual airframe sections in a high temperature test laboratory are then analyzed to aid in structure design. The Heat Rate Computer not only *calculates* the amount of electrical energy required by banks of infra-red lamps or other heat sources, but also *controls* the energy flow.

Calculation of the heat flow necessary for accurate simulation can be made by satisfying the thermal equilibrium equation:

$$Q = A\left[h(T_{aw} - T_s) - BT_s^4\right]$$

where Q = heat rate (BTU/hr)
A = area (sq ft.)
h = heat transfer coefficient (BTU/hr, sq ft. °R)
T_{aw} = adiabatic wall temperature (°R)
T_s = surface temperature of structure (°R)
B = radiation factor (BTU/hr sq ft. °R⁴)



The Heat Rate Computer solves this equation instantaneously using both digital and analog techniques, then sends energy to the heat source at the proper heat rate, Q. Transducers mounted on the airframe provide the feedback signal proportional to T_s.

One large computing system has been designed by General Electric to calculate and control the heat flow to 39 airfoil areas. The unique use of a magnetic drum to digitally store T_{aw} and h curves insures freedom from drift and permits easy storage of, and rapid access to curve data. Multiplexing and time-sharing minimize the amount of electronic circuitry.

COMPUTER DEPARTMENT LAUNCHES OPERATION UPTURN WITH NEW MILLION DOLLAR PLANT IN PHOENIX, ARIZONA



General Manager H. R. Oldfield, Jr., is pictured at the controls of the Operation Upturn steam shovel which recently broke ground for the new 104,000 square foot permanent plant which is expected to be completed by December of 1958.

"Our business is good and getting better," Oldfield said. "We're going to continue to expand during the year, adding perhaps a hundred or more people." The department now has over 800 employees.

The 160 acre site is located in Deer Valley Park, northwest of Phoenix along the west side of the Black Canyon Highway and south of the intersection with Thunderbird Road.

COMPUTING SERVICES GROUP HANDLES COMPLEX ORIGIN-DESTINATION STUDY FOR WESTERN CITY

The Computing Services Center of the G-E Computer Department recently completed an origin-destination tabulation for the Phoenix-Maricopa County Traffic Study Group in Phoenix, Arizona. The results of this tabulation, when analyzed, will enable the group to plan the street and highway development program of this desert metropolis for years to come.

The original survey information was obtained by the city county personnel using the interviewing procedures set up by the U. S. Bureau of Public Roads. The data was put on punched cards and then turned over to G-E for processing and tabulation.

Using manual, or simple computing methods, such tabulations often take many months—sometimes years—to complete. However, using the Computing Services Center Computer on a rental basis, the job was completed in just a few weeks. The Computer Department also performed the difficult programming job.

(Programming, simply stated, is the translation of the solution method into the language a computer can understand, and the insurance of instructions to the computer so that it will process the information it is fed.)

The Computing Services Center of G-E's Computer Department is staffed with 125 analysts, programmers, coders—all leaders in the computer field. Their services are available, along with time on the large and versatile type 704 computer, to handle the problems of industry, business, government and education.

For more information contact your nearest Apparatus Sales Office or Computer Department — Room 101, General Electric Company, 1103 North Central Avenue, Phoenix, Arizona.

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AVIATION CALENDAR

Sept. 29-30—Mid-Year Conference, Airport Operators Council, Mayo Hotel, Tulsa.
Sept. 29-Oct. 3—National Aeronautical Meeting, Society of Automotive Engineers, Ambassador, Los Angeles, Calif.
Sept. 29-Oct. 3—Semi Annual Meeting and Western Tool Show, American Society of Tool Engineers, Shrine Exposition Hall, Los Angeles, Calif.
Oct. 1-3—National Airports Conference, University of Oklahoma, Norman, Okla. Co-sponsored by American Assn. of Airport Executives and the CAA.
Oct. 2-4—Professional Pilots Symposium on Air Space, Salch, Society of Experimental Test Pilots, Beverly Hilton Hotel, Beverly Hills, Calif.
Oct. 4—Second Annual Awards Banquet, Society of Experimental Test Pilots, Beverly Hilton Hotel, Beverly Hills, Calif.
Oct. 6-7—National Symposium on Extended Range and Space Transmission, sponsored by Institute of Radio Engineers and George Washington University, Lisner Auditorium, Washington, D. C.
Oct. 7-8—1958 Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada.
Oct. 8-10—14th Annual Aviation Spark Plug and Ignition Conference, Champion Spark Plug Co., Secor Hotel, Toledo.
Oct. 9-10—Ninth Annual National Noise Abatement Symposium, sponsored by Armour Research Foundation, Hotel Sherman, Chicago, Ill.
Oct. 12-18—Sixth Annual USAF Weapons Competition, two tactical fighter phases. Tactical Air Command, Nellis AFB, Nev.
Oct. 13-15—ASME-ASLE Joint Lubrication Conference, Statler Hotel, Los Angeles, Calif.
Oct. 13-15—14th Annual National Flee

(Continued on page 6)

AVIATION WEEK Including Space Technology
September 22, 1958
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AVIATION CALENDAR

(Continued from page 5)

tronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 15-17—Twelfth Annual Meeting, Southeastern Airport Managers Assn., The Palm Beach Terrace, Palm Beach.

Oct. 20-21—Fourth National Aero-Commerce Symposium sponsored by Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

Oct. 20-22—1958 Annual Meeting, Assn. of the United States Army, Sheraton Park Hotel, Washington, D. C.

Oct. 20-22—National Safety Congress and Exposition, Aeronautical Industries Section, National Safety Council, Conrad Hilton Hotel, Chicago, Ill.

Oct. 20-30—Sixth Annual USAF Weapons Competition, interceptor phase, Air Defense Command, Tyndall AFB, Fla.

Oct. 22-24—Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Oct. 23-25—1958 National Simulation Conference, sponsored by Institute of Radio Engineers Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Tex.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 27-31—National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland, Ohio.

Oct. 30-31—1958 Electron Devices Meeting, sponsored by Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Nov. 6-7—Quarterly Regional Meeting, Assn. of Local & Territorial Airlines, Honolulu, Hawaii.

Nov. 6-7—Fifth Annual Meeting, Institute of Radio Engineers Professional Group on Nuclear Science, Villa Hotel, San Mateo, Calif.

Nov. 6-7—National Specialist Meeting on Dynamics and Aeroelasticity, sponsored by Institute of the Aeronautical Sciences Texas Section, Texas Hotel, Ft. Worth, Tex.

Nov. 10-12—International Conference, Physics and Medicine of the Atmosphere and Space, sponsored by the School of Aviation Medicine, San Antonio, Tex.

Nov. 10-13—11th Annual International Air Safety Seminar, Flight Safety Foundation in cooperation with Airways Modernization Board's National Aviation Facilities Experimental Center, Atlantic City, N. J.

Nov. 10-21—12th Air Transportation Institute of the American University, Washington, D. C.

Nov. 17-18—Sixth Annual Aircraft and Missile Division Conference, American Society for Quality Control, Biltmore Hotel, Dayton, Ohio.

Nov. 17-21—13th Annual Meeting and Astronautical Exposition, American Rocket Society, Hotel Statler, New York, N. Y.

Nov. 19-21—32nd Meeting, Aviation Distributors and Manufacturers Assn., Statler Hilton Hotel, Dallas, Tex.



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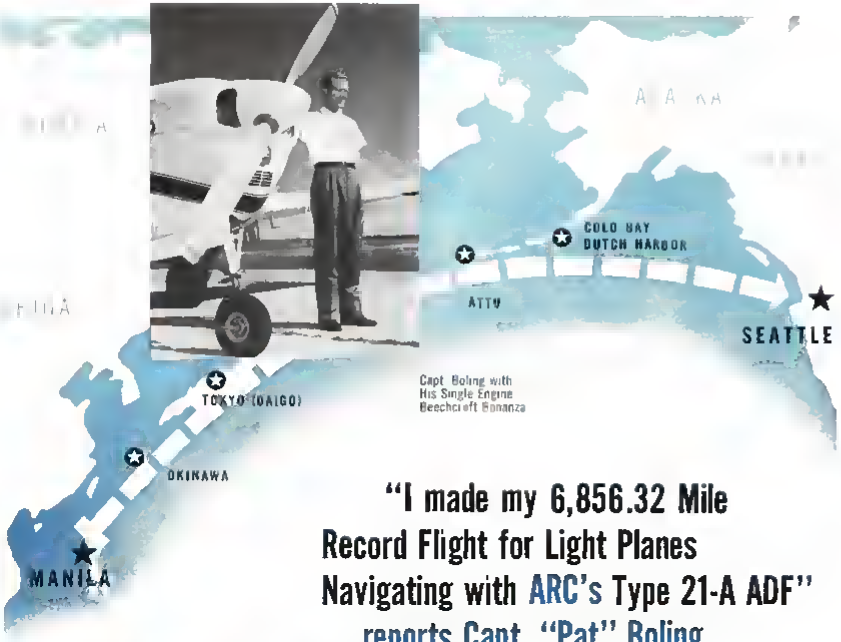
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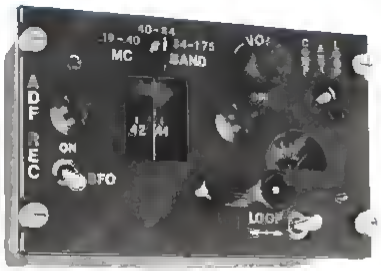
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On August 1st, 1958, Captain Marion ("Pat") Boling landed at Pendleton, Oregon, after a non-stop flight from Manila, P. I.—a distance of 6,856.32 miles in 45 hours and 42 minutes, thus establishing a new long distance record for light aircraft. His plane was a single engine Beechcraft Bonanza.

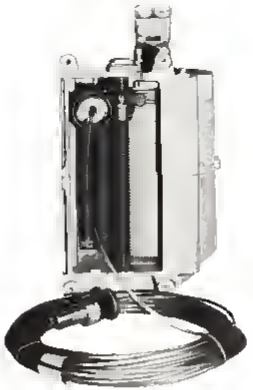
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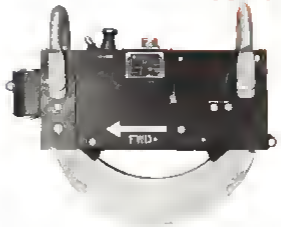
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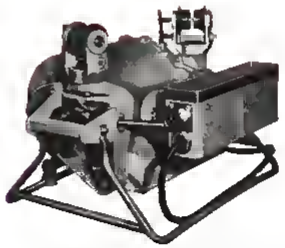
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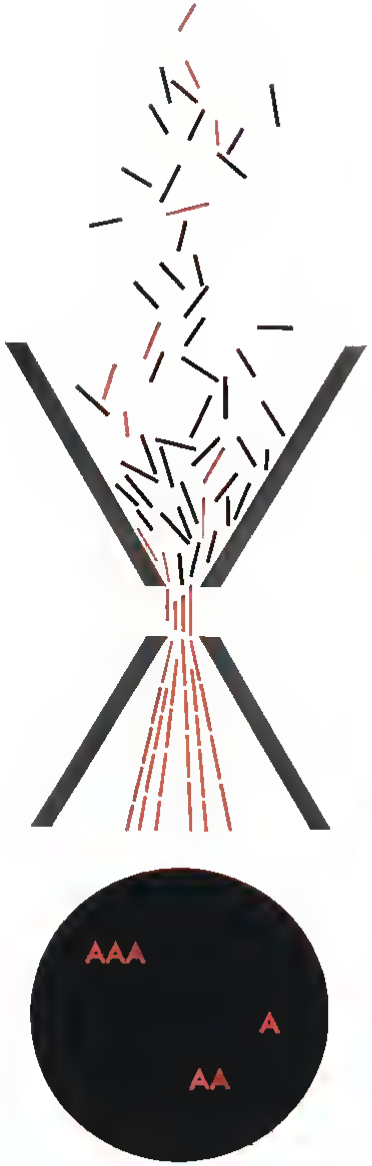
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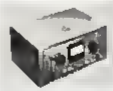
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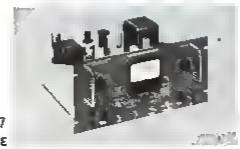
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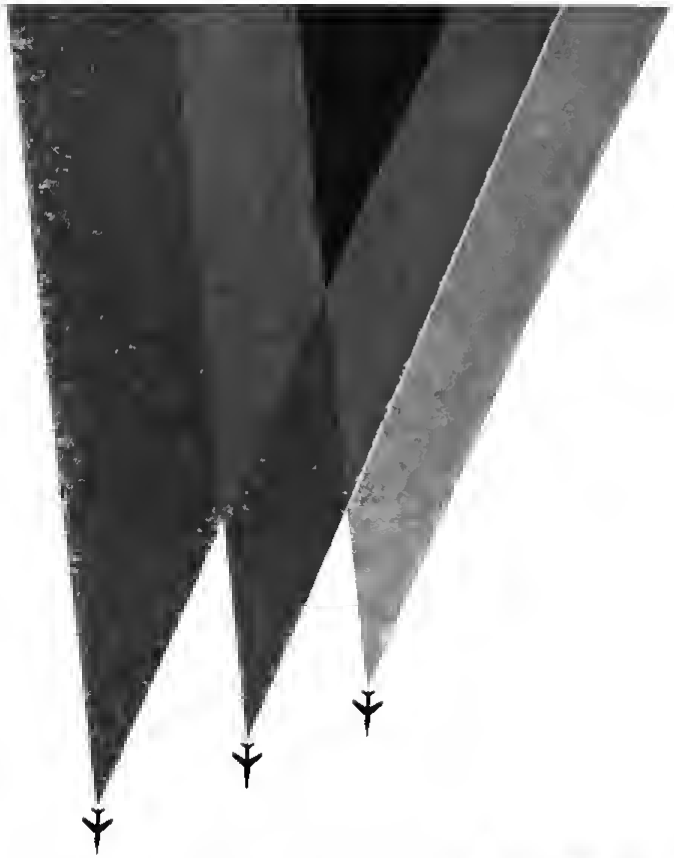
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COVER Saunders-Roe Black Knight ballistic re-entry test vehicle has been fired by British at Woomera test range near Canberra, Australia. Missile was designed at the Royal Aircraft Establishment. Saunders-Roe Ltd. is principal contractor and was responsible for most of the development and construction. Engines were developed by Armstrong Siddeley Motors Ltd. For other photos of Black Knight, see page 50.

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Economy vs. Progress

(Stuart G Tipton, president of the Air Transport Assn., last week delivered the airline industry's first public comment on the Cherington report, a detailed analysis of the economic problems facing the airlines and their relationship to the over-all economy of U.S. aviation (AW Aug 11, p. 28). Tipton, in a speech at the Wings Club of New York, commended the report's findings and added his own views as to how the airlines' financial ills can best be overcome. Because of its interest to the airlines and the industry as a whole, Aviation Week is reproducing below, major portions of the speech.)

I am speaking of the extremely valuable report entitled "The Status and Economic Significance of the Airline Equipment Investment Program." This important study was prepared for Gen Quesada President Eisenhower's special assistant, by Paul Cherington, professor of business administration at the Harvard Graduate School of Business. In transmitting this report to the Congress, President Eisenhower spoke of the jet equipment program of the airlines, and said:

"This program is of such size as to hold some significance to the national economy over the next few years."

We feel that statement by the President, while gratifying, is very much on the conservative side. As is amply documented by Professor Cherington, the more than $3 billion jet investment is important to the economy as a major private investment program. Its success is not only vital to the airlines, the national defense and the public, but to some 5,000 business concerns—aircraft and engine manufacturers, their suppliers, and others.

The burden of the report is that aviation, as a relatively new but growing and essential industry, needs government policies that create a climate of opportunity. That is why I feel this report is pertinent to all aviation, even though it stressed air transport.

All elements of aviation, from the transport operator to the manufacturer of space ships, have a similar pattern of problems. You know, I am sure, to what I am referring: expensive and risky lead time, high cost development and experimentation and a fantastic rate of obsolescence.

These problems generate an atmosphere that is familiar to all of us—a constant, almost frantic effort to advance the industry. This effort, as we know, is not merely to maintain a competitive business position, but also to serve an additional and heavy burden of responsibility—the national security.

However, because of these problems, the aviation industry is highly vulnerable to economic storms and to adverse or inconsistent government policies. So, we have a paradox. On the one hand, the government demands of the industry that it meet its broad responsibilities. The industry responds but, unfortunately, federal agencies still fail to recognize that an adequate rate of return is required for the continual and tremendous investment in progress.

The public interest will only be served when we have government policies that match the industry's responsibility.

This new White House report, however, points the way in this direction. It makes it abundantly clear that the "old ways," the so-called "tried and true" ways have and can continue to hamper or cripple the development of aviation. Those of us in transportation are particularly aware of the damage that can be caused by the routine application of outmoded regulatory concepts.

. . . The profit margin for the domestic trunklines during the first six months was only 1.1%. Comparatively speaking, the domestic airlines suffered a reduction in net income almost three times as great as the general business decrease reported by the First National City Bank. Incidentally, the volume of airline business, in terms of passenger miles, was about the same in the two six month periods. Clearly, the decline in profits results directly from the increased cost of doing business. This profit squeeze is produced by rising costs and the Government imposed ceiling on fares. The modest increase granted in February was simply not large enough to do the job.

The Quesada Cherington report warned that the "the present economic situation of the airlines is unsatisfactory and is deteriorating" and urged government policies that would permit, and even encourage, the greatest possible freedom for airline managements to meet the problem. In fact, the report contained this blunt conclusion:

"The precise method of effecting a short-run increase in revenues should be left up to the carriers."

For this reason we wonder what the Civil Aeronautics Board will do with the various tariff filings that have been made recently. We also are waiting for Board action on the industry's request to meet and discuss the many out of date promotional tariffs and discounts. This was rejected previously, but we have asked for reconsideration. Any agreements arrived at in such a meeting, incidentally, would be reviewed by the Board. It is hard therefore, to see any damage to the public interest that can be caused by talk when action is so controlled.

Recently there have been some hopeful signs indicating a new awareness on the part of the Board . . .

It may well be that the CAB has finally realized that the scheduled air transport industry is a highly competitive, dynamic industry. That the precise mathematical formulae developed for the classic forms of monopoly utility do not do the job. That the final result—better service for the public and the national defense—is paramount, not routine adherence to a traditional regulatory approach.



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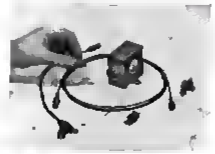
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Ramsey C. Armstrong, board chairman, the Sterraeim Corp., Burbank, Calif., C. Hart **Miller** succeeds Mr. Armstrong as president. Also, George L. Wiser, vice president engineering, and **Kenneth P. Bowen**, vice president manufacturing.

John J. Velesky, a director and vice president, WacLine, Inc., Dayton, Ohio. Mr. Velesky continues as chief engineer.

Harry Horowitz, president and general manager, Electro-Miniatures Corp., Ridgefield, N. J.

Henry H. Michaels, Jr., executive vice president, Aircraft Radio Corp., Boonton, N. J.

Robert Dressler, executive vice president, Automatic Corp., New York, N. Y. Also, **Albert Chesnes**, vice president operations, and Dr. **Ulrich K. Heidelauf**, vice president systems planning.

Arthur H. Bolt, vice president engineering and production, Triad Corp., Pacoima, Calif.

Frank J. Reynolds, vice president-operations, Stand Engineering, Inc., Plainfield, N. J. **W. A. Schneider**, a vice president, will assist Mr. Reynolds as director of engineering. Also, **J. H. Hunt**, director, manufacturing, and **B. E. Hescock**, manager, preliminary design. **H. J. Bradfield** succeeds Mr. Reynolds as director-contracts and sales.

James E. Gibson, senior vice president and treasurer, Leach Corp., Compton, Calif.

Maj. Gen. George F. Smith (USAF ret.), vice president and general manager, Government and Industrial Products Division, the Magnavox Co., Ft. Wayne, Ind.

Edward A. Malling, vice president, marketing, Flexmetics Corp., Maywood, Ill.

Marvin L. Davis, vice president-sales, and **Chris F. Whelan**, vice president-economic planning (jet program), Continental Air Lines, Inc.

O. A. Wright, a vice president, Actuation Research Corp., Glendale, Calif.

Robert E. Worrall, vice president-production, American Super-Temperature Wires, Inc., Winooski, Vt.

Clarence D. Shepard, temporary chairman, Canadian Air Transport Board, Ottawa, Canada, succeeding W. J. Matthews, deceased.

Honors and Elections

Henry Rempt, director of Lockheed's Electronics and Armament Systems Division, has been elected president of the Institute of Navigation, Los Angeles, Calif.

Lt. Col. Lillian T. Robinson, USAF, has been awarded the Air Force Commendation Medal for [illegible] performance of outstanding duty while serving as the Air Research and Development Command Project Officer with the Scientific Advisory Board Ad Hoc Committee on Research and Development.

James C. Floyd, vice president engineering of Avro Aircraft Ltd., has been invited by the Royal Aeronautical Society to deliver the annual British Commonwealth Lecture.

(Continued on p. 115)

INDUSTRY OBSERVER

► Decision on award of an assembly and test contract for Air Force's Minuteman multi purpose ballistic missile is scheduled to be announced on Oct. 15. Proposals were submitted by a large number of industry members early this month. Douglas Aircraft Co. and General Motors Corp. reportedly are among the top contenders.

► North American X-15 high-altitude, high-speed research aircraft is scheduled to be completed by mid-October, ahead of schedule. The aircraft will be trucked to Edwards AFB, Calif., soon afterwards. North American test pilot Alvin White, who will backstop company pilot Scott Crossfield in the early phases of the program, is now going through the preparational training phases.

► Significant increase in speed of supersonic jet aircraft is predicted through reduction in base drag made possible by application of new principles for configuring afterbody shape of fuselage or engine nacelles developed by scientists at National Advisory Committee for Aeronautics. Current NACA afterbody configuration principles are being tested using a small Mach 2 rocket engine to simulate a jet engine at the agency's Wallops Island station.

► Interest in pyrophoric fuels for ramjet applications is growing. More reliable ignition, smoother burning at higher altitudes and lower temperatures plus a significant weight savings in the propulsion system hardware are among the primary reasons behind the interest. Development of ramjet engine to use pyrophoric fuels is underway at both Curtiss-Wright (AW March 24, p. 19) and Allison Division of General Motors.

► Soviet Air Force instructions to crews of interceptor aircraft refer to a device that indicates whether the target bomber is carrying a nuclear bomb or a bomb of conventional explosives. If the device is inoperative or if their interceptor is not equipped with the device, Russian crews are instructed to attack on the supposition that the bomber is carrying a nuclear bomb. While no definite mention is made of ramming, the Soviet pilots are ordered to stop an enemy bomber carrying a nuclear bomb at all costs.

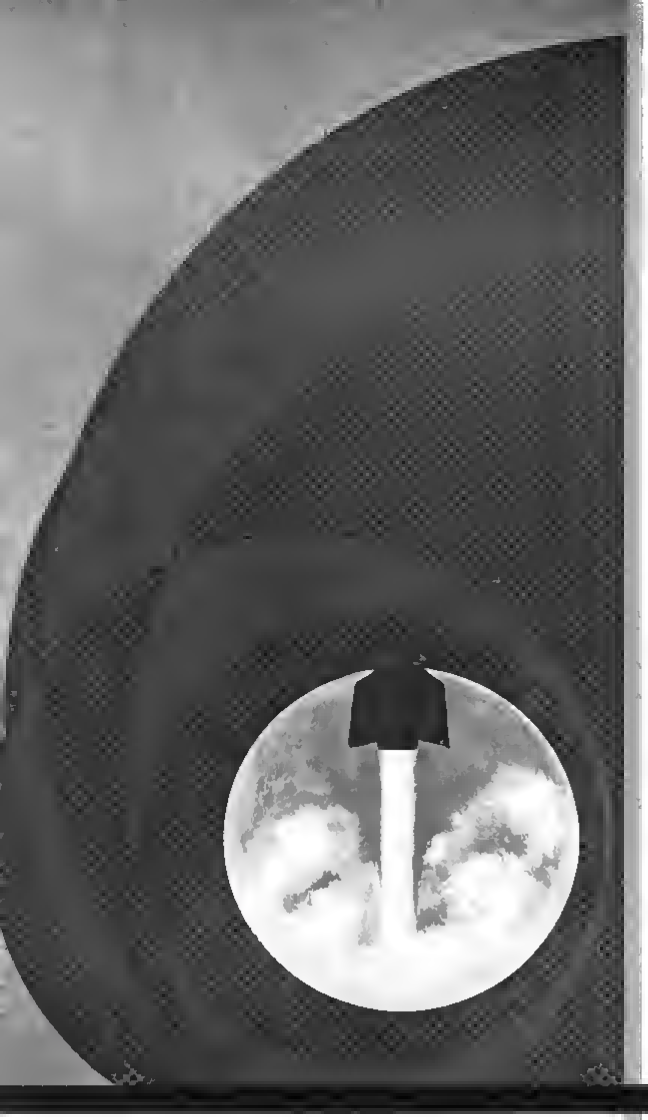
► Phasing of Lockheed C-130B Hercules turboprop transports into Tactical Air Command will give TAC four wings of C-130s with 48 aircraft per wing. First B models will go to the 463rd Troop Carrier Wing at Ardmore AFB, Okla. Ardmore wing's A models will be shifted to other wings, making two wings in the U.S., one in Japan and one in Europe.

► Navy is considering research on problems associated with underwater escape from downed aircraft with the hopes of eventually developing an underwater ejection system. Studies at present are aimed primarily at determining the maximum depth at which a crew member can successfully extricate himself from a submerged aircraft and at finding better means of escaping from conventional aircraft. Program is under the cognizance of the Naval Air Development Center at Johnsville, Pa.

► Royal Norwegian Air Force is converting from Republic F-84G fighters to North American F-86Fs. Other U.S.-built aircraft in use by RNAF include Republic RF-84Fs, North American F-86Ks, Lockheed T-33s for instrument training, and Consolidated Vultee PBY-5A Catalinas for air-sea rescue work.

► In recent deployment of Tactical Air Command F-100D fighters to Adana, Turkey, at the height of the Lebanese crisis, spares were used to complete the 6,470 mi. nonstop flight of the first 18 planes from Myrtle Beach AFB, S.C., but eight more sent two days later completed the 12 hr. flight without spares. Wing used on first flight had only six hours notice before takeoff. Average speed with three refuelings enroute was 582 mph., a record.

► Royal Australian Air Force and Army are re-evaluating their decision not to purchase helicopters and may place an initial order for several units within the near future. At present, Navy is the only Australian military service equipped with helicopters.



ACOUSTIC NOISE

When huge rocket engines lift a ballistic missile or satellite vehicle into the air, the thundering noise of the engines violently shakes intricate electronic components and the missile structure itself. Acoustic noise is one of the many environments that must be thoroughly explored and understood by the missile designer.

But it is expensive and impractical to conduct acoustic noise tests by operating rocket engines on the ground. Noise—of the same frequencies and amplitudes as rocket engine noise—must be produced in the laboratory.

Engineers at Avco's Research and Advanced Development Division have met this problem by designing a versatile high-intensity acoustic noise generator. Based on electromagnetic principles, it creates noise environments of the same frequency spectra as rocket or jet engines.

This successful effort is now part of the division's complete environmental testing laboratory, where it is producing information for Avco scientists and engineers responsible for ICBM nose cones.

Acoustic noise work is one of the many development programs that proceed simultaneously with theoretical and applied research at RAD. The mutual stimulation of scientists and engineers in many disciplines occurs naturally at Avco, where the search for new knowledge and its application go forward under one roof.

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Washington Roundup

Specialist Scarcity

Analysts who have carefully scrutinized the financial picture of the airline industry are becoming alarmed at the scarcity of airline specialists within the money market. One economist points out that large insurance companies which have backed or are considering backing airline re-equipment programs with long-term loans, probably don't have more than "six or seven" informed airline specialists immediately available to them. He contrasted this number to the "dozens" of specialists in other industrial areas on most insurance company staffs. This problem, coupled with the fact that a number of airlines have not yet had wide experience in handling large-scale financing programs, poses a number of inherent hazards to a long-range financial program that embraces well over $2 billion.

Smouldering Resentment

Smouldering resentment against President Eisenhower's veto of the Federal Aid to Airports bill (Sept. 15, p. 28) came out into the open in Miami Beach, Fla., when 100 mayors and key city officials—Republicans and Democrats alike—sharply criticized the Administration's stand on the issue.

Attending the Conference of Mayors of the U. S., the group is representative of those who have been hit hardest by the veto, but other protests will follow, particularly from state government officials, building to a reaction that can hardly be called helpful to the Administration in an election year.

In general, the mayors warned that airport development programs, now tailored to cope with jet transport operations, will be seriously delayed by the presidential move. They passed a resolution asking Congress and the President to restore the program and provide $100 million grant-in-aid annually for the next four years. They added that state and municipal governments just don't have the funds to back projected airport development programs.

Challenge by Boeing

Boeing Airplane Co. touched off a spark of controversy last week when it objected to changes in jet transport operations during the Civil Aeronautics Board's annual civil air worthiness review. Joined by the Aircraft Industries Assn., the manufacturer came into conflict with CAB over Special Regulation 422A takeoff formula which has the effect of increasing minimum takeoff field lengths for jet transports or else may require extensive design changes in the already existing aircraft to comply with the change. Boeing asked for time to offer its own interpretation of the complicated takeoff formula posed by SR 422A and to gather certification data.

Lighting Decision

Heavy volume of comments favoring the Adams-Honeywell anti-collision light system for aircraft has resulted in a Civil Aeronautics Board Bureau of Air Safety decision to delay adoption of proposed amendments to civil air regulations for aircraft exterior lighting requirements.

As proposed, the amendments call for removal of the present rotating red anti-collision light and an increase in intensity of the red and green wing tip and white tail navigation lights. Bureau spokesmen now say that no action will be taken on the proposed changes until they meet with military and civilian supporters of the Adams system which produces a white light of unusually high intensity.

Trace Decision

Airways Modernization Board decision on choice of contractor to develop Taxiing and Routing of Aircraft Coordination Equipment (TRACE) for expediting airport surface traffic is expected before end of the month. Original field of 14 bidders has been narrowed down to four finalists; two of the four are team bids submitted by Airborne Instruments Laboratory/Automatic Signal Division of Eastern Industries and by General Railway Signal/Radio Corp. of America.

Minetti Dissent

Civil Aeronautics Board member G. Joseph Minetti is rapidly accumulating an impressively long list of dissensions on Board opinions which endorse rate of return increases and now stands as the number one exponent of a hold-the-line policy on airline rates and fares.

Minetti couldn't see eye-to-eye with his colleagues when they recently voted—on the recommendation of the Board staff—to increase the rate of return on investment of Mohawk Airlines and Southern Airways from 8% to 9.5%. He dissented in both cases.

And last week, he filed another dissent when the Board voted to approve United Air Lines' "DC-7 Custom Coach" tariff. In this instance, he prefaced his dissent with a remark that may be an insight to his basic philosophy on the subject of fares saying, "... the increase in regular coach fares reflected in this tariff, if widespread, may tend to discourage the growth in low-priced air transportation which is so necessary to success during the years of equipment expansion that lie ahead."

Close Estimate

Fiscal 1958 budget estimates presented to Congress in March by Air Force, Navy and Army Fiscal officers turned out to be almost exactly right. Although final figures are not yet in, early estimates came within six one-hundredths of 1% of actual expenditures. The Air Force estimate was $6 million above actual expenditures, the Navy $7 million under and the Army $1 million under.

ICAO Navigation Battle

U. S. has begun to lay the groundwork for the sales campaign it will be forced to wage at the International Civil Aviation Organization special meeting on short distance navigation aids Feb. 1 if it expects Vortac to be adopted as a part of the international navigation system. U. S. lost ground during the bitter Tacan controversy and the resultant switch from VOR and DME to Tacan substantially weakened U. S. prestige in the international navigation field. Meanwhile, the British have been strengthening their position with the Decca system and can be expected to push Decca vigorously as an international system during the ICAO meeting. (See p. 32 for British move in the New York area.)

First step the U. S. is taking to build up the Vortac system is an international symposium Oct. 1-4 in Washington for foreign governments and other aviation interests.

—Washington staff

Space Flight May Be $4 Billion Market

Employment may reach 500,000 in 15 years; R&D will get major emphasis, Rocket Society told.

By Michael Yaffee

Detroit—Space flight will be a $4 billion industry employing 400,000 to 500,000 people within 15 years. This is the opinion of Rocketdyne's George P. Sutton, president of the American Rocket Society, which held its fall meeting here last week.

Not quite one year old, space flight, according to Sutton, is in the same position nuclear energy was in 15 years ago and can be expected to make the same progress in the same amount of time. Other people were less optimistic.

Six experts selected to discuss the impact of space flight on American industry concluded that space flight will probably never be classified as "big business" in the accepted sense of the term. The consensus among panel members was that space flight might best be compared to shipbuilding. They felt that it will have a strong impact on industry but that it will be a selective one rather than a matter of brute numbers and large profits.

Space flight will never be a mass production industry, said panelist Karl J. Bossart of Convair-Astronautics. Manufacturing will be limited to experimental or quasi-experimental models. There will be no production lines comparable to those for aircraft unless there is an unforeseen breakthrough in the propulsion field, he said.

Interplanetary flights are just too expensive in terms of practical dollar and cents economic returns, Bossart declared. It would cost $750,000, for example, to send a 1-lb. payload to Mars and back. The schemes for economic exploitation of other planets are pipe dreams. Nor does he believe that it will prove attractive from a military viewpoint.

This leaves as incentives for large expenditures of money on space flight the contribution to scientific knowledge and the enhancement of national prestige. The first has traditionally suffered from starvation budgets, said Bossart and, while large sums have been spent on the second in the past, they are never spent on a repetitive basis.

Satellite Value

Artificial satellites around the earth are another matter, they have both military and civilian value. But Bossart believes that a very moderate number of these vehicles will suffice.

In space flight, the emphasis will continue to be on research and development rather than on manufacturing. A great effort is needed in the applied sciences. Breakthroughs are needed and will come. (Bassart sees the attainment of reliability and long life of components as one job that will require a major, and perhaps the greatest, development effort.) And to support these efforts, ample research laboratories and elaborate test facilities will be needed.

Consequently, in Bossart's opinion, the effect of space flight on industry will be to accelerate trends already evident. Design offices and test laboratories will expand at the expense of manufacturing facilities. The proportion of engineering and technical personnel to manual laborers will increase greatly. Capital expenditures will grow to the point of becoming the lion's share of manufacturing costs.

Panelist John de Nike, astronautics project manager of the Martin Co., strongly disagreed with Bossart's contention that interplanetary travel was of no military value.

De Nike believes that placing a man in space should become our primary objective. He disclosed that Martin had completed initial phases of a study on the problem of setting up a manned outpost on the moon.

Man in Space

Dr. Nike conceded that it would be impossible to prove the value of such missions now. But the trouble with current space planning, he said, is that it lacks firm, long-range objectives. So the thing to do is to start by putting a man in space as the basic mission and letting the other missions evolve from there. At the time, nobody could have proved the value of the Wright brothers' airplane, he declared, in terms of the bombers that eventually were to follow.

George E. Valley, Jr., chief scientist of USAF and a panel member, expressed the belief that primary use of space flight during the next 10 years will be in support of basic research on the properties of space and of the nearest planets. But it was also his opinion that relatively few of these specialized vehicles would be required for the job.

Somewhat larger quantities may be turned out on some of the more standard items involved in space flight. Among the possibilities he named the following:

- **Booster rockets.** It might prove most economical to establish a line of two or three standard sizes of first stage boosters which could be used to lift diversified loads.
- **Data recording** apparatus and perhaps telemetering equipment if it proved susceptible to sufficient standardization. But it is doubtful that output of even such items as these would ever become large in terms of normal present-day production.

Space Project Teams

At the same time, however, Dr. Valley believes that the construction of the highly specialized vehicles required for space work will have a rather significant impact on the usual work pattern in industry.

The reliability and detailed engineering knowledge needed in building the vehicles will in all likelihood remain beyond the capability of the scientist most directly concerned. As a result he feels that we shall see projects in which a missile manufacturer teams up with a basic research group, perhaps a university group, in the joint design of special space vehicles.

But industry will profit most, Dr. Valley said, from the indirect results of space research which very likely will give rise to discoveries applicable and exploitable in devices useful for other purposes than space flight itself.

This was also the opinion of two other panel members. Brig. Gen. Homer Boushey, first director of advanced technology, USAF, and Richard Cesaro, Advanced Research Projects Agency.

They envisioned military benefiting from the "fall-out by-products" of space flight in many ways. Most notably they foresee new and radical advances in metallurgy, reliability, solar development, weather control and navigation.

Military Value

Disagreeing to some extent with Dr. Valley and Bossart, Gen. Boushey said that the first (and following) space vehicles will be of great value to the military in developing and improving communications navigation, weather reporting and control, detection and warning systems, anti-missile and anti-satellite systems and lunar bases.

Like most of the others, however, Gen. Boushey could not see the existence of any large production at least in the next 20 years. There will be a call for a few thousand spacecraft at most. These will be custom-made, of very high quality, and will require contractors and workers with unique skills.

Since most of this work will be of a research and development nature, Gen. Boushey declared, contracting procedures will have to be changed to permit industry to make a greater profit on R&D contracts.

To Richard Cesaro, the greatest impact of space flight on industry will be the rapid advances in almost all fields of technology that government-sponsored research in this area will make possible. He does not discount interplanetary travel but believes man will be limited initially to the moon, Mars and Venus because of the distances involved between those bodies.

Propulsion is the key to space flight, according to Cesaro. As currently envisioned, the first space propulsion power will be provided by an ICBM first stage in combination with a high energy-fueled second stage. (Real high energy fuels serve little purpose in the first or lower stages of a multi-staged vehicle, he said, and so will only be used in upper stages.) This will be followed by the combination of a 1.5-million lb. thrust booster—probably one of the liquid units now under development at Rocketdyne—and an ICBM.

Following this will come combinations of two or more 1.5 million lb. thrust engines.

Nuclear propulsion may prove space flight's greatest boon someday. But all of a dozen missile engineers spotlighted by AVIATION WEEK at the ARS meeting believed that it was a long way off and were fairly positive that the first, and many following, manned satellites and non-orbiting space vehicles will be propelled completely by chemicals.

Simplicity Wanted

Panel member Willis M. Hawkins, general manager of Lockheed Missile Systems Division, took exception to all the emphasis being given to reliability. Most companies, he said, should have vice presidents in charge of simplicity.

Companies have gone overboard on reliability in some spots. Engineers must be reminded that the idea is to create an operational system, not a scientific monument. In the past, engineers have made systems work that should have been left in the bottom drawer. Reliability should be built into the basic design.

In regard to the impact of space

Army Super Booster

Washington—Contract for a clustered 1.5 million lb. thrust rocket booster for early use in space projects was awarded to Rocketdyne Division of North American Aviation Inc. last week by Army Ballistic Missile Agency.

Booster will combine engines similar to those used in Jupiter, Thor and Atlas ballistic missiles and should be ready for use earlier than the 1.5 million lb. single-chamber engine ordered from Rocketdyne by Air Force.

The $2 million ABMA contract is a high-priority Advanced Research Projects Agency program. Direction of the USAF single-barrel project will be taken over by the National Aeronautics and Space Administration (AW Aug. 11, p. 1").

Army said clustering of existing engines "is considered the quickest and least expensive means of obtaining a propulsion system for placing very large payloads into orbit."

Rocketdyne will carry out the work at its main plant in Canoga Park, Calif., under Roy Healy, Jupiter engine program chief. Components will be tested at its Propulsion Field Laboratory in the Santa Susana Mountains. Static test facilities at ABMA's Redstone Arsenal site, stressed for one-million lb. thrust engines, will require "relatively minor modifications for the initial project," Army said.

Lunar Delay Explained

Washington—Second Air Force lunar probe launching attempt was delayed for precautionary reasons after a possible problem was discovered during static tests. Refinements already had been made in Rocketdyne first-stage engine's valve structure and other plumbing components as a result of the investigation of the failure of the first lunar attempt on Aug. 17.

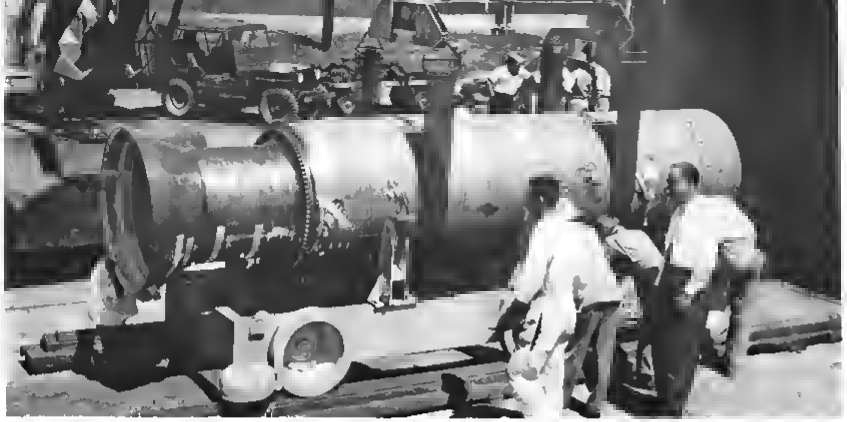
Recovery of the thrust chamber, turbopump assembly and smaller fragments of the first stage engine from the first firing confirmed telemetry data received during the 77 sec. of flight that preceded the explosion. Possible cause of the plumbing trouble was the long time during which liquid oxygen was kept in the vehicle. This was required by holds built into the countdown in an attempt to hit the target launching time precisely. Countdown on the next firing will be shorter, as a result of techniques learned in the first attempt.

Unless new problems arise, next launching attempt probably will be made about Oct. 12. Meanwhile USAF has taken delivery of seven third-stage engines for moon rockets—four for use on vehicles and three for testing. They are the 7,500 lb. thrust Allegany Ballistic Laboratory engine developed for later Vanguard satellite vehicles.



Regulus II Fired From Submarine

First firing of Chance Vought Regulus II missile was made last week from submarine Grayback, about one mile off Ft. Mugu, Calif. Landing gear of recoverable missile failed to respond to chase plane commands and Regulus was belly-landed successfully; however, friction started fire and missile was destroyed. Controlled flight to Edwards AFB covered about 200 mi. Malfunction cause is not yet known.



Army Tests Thiokol Solid Fuel Engine

Technicians unload Thiokol Chemical Corp.'s solid propellant missile engine preparatory to first test firing at Army's Redstone Arsenal Huntsville, Ala. Static test was termed "completely successful" by Army and Thiokol. Engine develops 450,000 lb. of thrust (AW Sept. 1, p. 27) and Department of Defense indicates it will be used as booster in Army's Nike Zeus anti-missile missile.

flight on industry. Hawkins felt that this will show itself primarily in the changing nature of the business, and in the need for flexibility on the part of the contractor and in the creation of a new environment for development profit. Most of the problems stem from the fact that science has created a giant and there will not be enough money to feed it and only a few of its muscles can be flexed at any one time.

One important change cited by Hawkins is the character of the personnel required by the new space industry. They will cover a far wider range of research specialties. In the airplane business 44 different research specialists are needed and the space industry already requires 63 different research specialists. Technical people constitute 19% of the work force in an aircraft plant. In a space facility, this figure jumps to 43%.

Among other things the high percentage of people engaged in research and development makes the problem of maintaining continuity in employment of technical personnel exceedingly difficult for the space company. Previously, when less than 20% of the work force was engaged in research and development it was comparatively easy carrying these people when work ran out.

The increasing ratio of research and development to production work in the space industry also has other drawbacks, Hawkins said. Research and development work is costly. It requires expensive facilities and high priced technical talent. Its profit margins are lower. And most important, there will be no large production to make up for mistakes in contract estimates and for the costly facilities that may be obsolete tomorrow.

Monopropellant May Compete With Solid Fuel in Future Missiles

Detroit—Liquid monopropellants, heretofore restricted primarily to secondary power generation in missiles, are now considered serious contenders for primary propulsion applications in vehicles all the way up to the ICBM class with particular emphasis on missiles of the Polaris and Minuteman type in which storability will be a primary consideration.

Recent technical gains in propellant work have enabled researchers to develop the first group of monopropellants with specific impulses significantly above the previous 170-220 level of compounds as ethylene oxide, hydrogen peroxide, hydrazine, and nitromethane. This fact coupled with the government's growing interest in and emphasis on storability virtually assures monopropellants of an important role in the future propellant spectrum, according to many chemists who gathered here last week to attend a confidential session on monopropellants at the fall meeting of the American Rocket Society.

This is not mere speculation on the part of monopropellant advocates who have kept faith in face of the comparatively spectacular and more publicized advances that have taken place or are underway in the liquid bipropellant and solid propellant fields.

Charles W. Tait of Wyandotte Chemical Corp., one of the more active firms in the field, told AVIATION WEEK that his company and others have been successfully firing small scale monopropellant-fueled rocket engines for some time and getting comparatively high specific impulses. Tait, who was chairman of the session, said, it is time now to scale up and disclosed that Wyandotte is now discussing a contract for this purpose with Navy BuAer. (To date monopropellant work has been underwritten largely by Navy contracts with the Air Force sponsoring a fairly extensive R&D program at Phillips Petroleum Co.) It is fairly certain that a full scale engine could be operating within three years.

Wyandotte, Phillips and Stauffer Chemical Co., a third firm active in the field, are working with different materials. Wyandotte has successfully tested at least two different high energy monopropellants. However, recent reports of attainable goals of 300-sec. specific impulses are way off the mark.

Monopropellant researchers will be happy with specific impulses comparable to those currently attainable with operational solid propellants—approximately 240 sec. Theoretically the specific impulse limit for monopropellants is about the same as that for bipropellants, but the practical operating limit for chemical monopropellant—discounting those such as free radicals—will probably prove to be close to 250 sec.

Solid Fuel Research

Tait is aware of the effort to provide the Polaris and Minuteman with solid propellants having a specific impulse of 260 sec. and of the work to develop real high energy solids based on boron. But the Polaris and Minuteman propellant work is still in the development stage, he pointed out, and it is unlikely that solid propellants will ever achieve a working specific impulse above 300 sec. A more realistic operating limit for solids, in fact, would probably be closer to 275 sec. If solid propellant people can reach their goals or the monopropellant goals faster than the monopropellant chemists, then Tait concedes that the solids would be a better choice than the monopropellants.

Solids are definitely the competition for monopropellants. In comparison with liquid bipropellants at present, both offer the missile user—generally at the expense of specific impulse—system simplicity and storability. Simplicity means less weight and more reliability. The monopropellant system, for example, requires only one propellant tank, the solids, none. The monopropellant system requires only about half the propellant control valves of the liquid bipropellant system, the solids none. Neither solid nor monopropellant systems require such things as mixture ratio control needed in liquid bipropellant systems.

Storability is another matter. To the missile user it means shorter readiness time, more reliability, more flexibility (powerplants can even be prepackaged), more mobility and lower costs. For example, there is little or no need for expensive and cumbersome fuel handling and storage equipment. There are some liquid bipropellant combinations now available that can be considered storable. A new publication compiled by Rocketdyne lists among storable propellants hydrogen peroxide and RP-1, nitric acid and ethyl alcohol, and nitrogen tetroxide and hydrazine. But many chemists believe that, all things considered, the storability of monopropellants and solids is generally superior to that of known liquid bipropellant combinations.

To obtain all these desired characteristics particularly the high specific impulse monopropellant researchers have had to make imposing technological advances. But the major problem in developing a high energy monopropellant, Tait explained, is trying to get high performance while keeping the material desensitized. It is comparatively easy to get materials with high energy. The trick is in keeping them from becoming high explosives instead of propellants.

A clue to the second major development in monopropellant research, which could turn out to be more significant than the first, can be found in what almost amounts to a redefinition of the term monopropellant. Originally, a monopropellant was conceived of as a material such as hydrogen peroxide in which the oxidizer and fuel elements were chemically bound in the same molecule. As it is defined by Tait, the term now covers materials in which oxidizer and fuel are simply joined physically. (Theoretically, solid propellants come under the definition, but traditionally the term monopropellants is reserved for liquids.)

High Energy

What it amounts to is that the new, high energy monopropellants may well be essentially bipropellant systems in which researchers have found some way other than physical separation to keep fuel and oxidizer materials from chemically combining or burning until ignited by an electrical squib or spark plug. This of course, opens the door to a large number of materials and monopropellant possibilities.



Lockheed F-104s Operational on Formosa

Squadron detachment of Sidewinder equipped Lockheed F104s from Air Defense Command at Hamilton AFB, Calif., was operational within 24 hr. after airlift to Formosa aboard Douglas C-124s. What was described as greatest concentration of air strength in the Far East since the Korean War included Tactical Air Command F-100s, C-130s, F-101s, RB-66s and B-57s flown into Okinawa, Formosa, Philippines area, F-86s from the 16th Fighter Squadron, 5th Air Force, Marine Airwing 11 from Japan flying FJ-4s and F4Ds, plus Seventh Fleet air strength which includes F8Us and Douglas Skyraiders. Matador missiles previously were deployed to the island. Nuclear warheads reportedly have been stockpiled.





Martin YP6Ms fly in formation over Maryland. Two XP6M-1s and five YP6M-1s have accumulated more than 170 hr. flight time

Seamaster Flies in Formation, Beaches Itself



Vehicle is used to facilitate beaching and ground handling of the P6M at the company's seadrome, Middle River, Md. Seamaster formerly was beached by use of attachable wheels and was moved on land with aid of tractors and six or more personnel. Hydraulically operated pressure pads grasp seaplane's sides when it taxis into gear. Aircraft's turbojets then supply taxiing power.



Seamaster approaches floating beaching vehicle. Beaching gear has steering and braking mechanisms controlled by the P6M pilot. The Martin Co. is building 24 P6Ms for the Navy. The P6M has unrefueled range of 1,500 mi. with 15 ton payload (AW Feb. 3, p. 39)

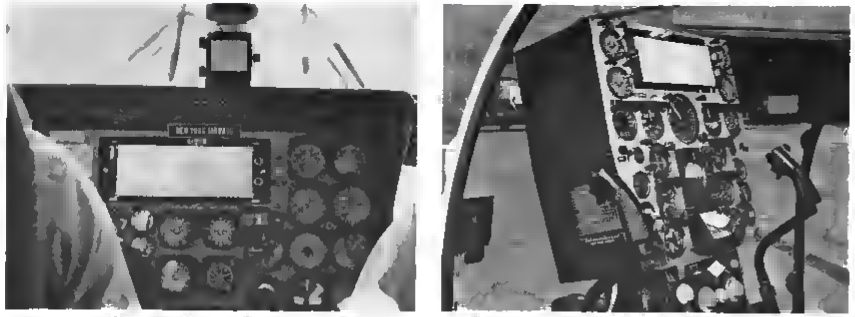




After maneuvering into the beaching vehicle, the P6M taxis toward ramp (left) and beaches itself (right). Aircraft is one of six evaluation P6Ms powered by four Allison J71 turbojets (10,000 lb. each) equipped with takeoff afterburners.



Construction is under way to modernize a seadrome at NATC, Patuxent River, Md. The first YP6M-1s are scheduled for delivery to NATC for Navy Preliminary Board of Inspection Survey trials next spring. After trials, P6Ms will be modified to P6M-2s.



BENDIX-DECCA installation is shown in New York Airways' Vertol 44 helicopter (left) and Airways Modernization Board H-13H helicopter (right). Flight log display traces aircraft track by pen on specially prepared map while decometers (coordinate indicators) show map grid position. In Vertol four decometers are mounted below flight log, in H-13H on both sides of flight log.

AMB Tests Navigation Aid in Helicopters

By James A. Fusca

New York—Evaluation by the Airways Modernization Board of the British-developed Decca hyperbolic navigation system is under way in the New York area. Object of the program is to determine the system's usefulness in assisting helicopters to navigate under instrument flight conditions. Helicopters presently are restricted to visual flight rule conditions.

As part of the program, a Decca chain of four ground transmitting stations has been set up by Decca company's U.S. licensee Pacific Division, Bendix Aviation Corp., and receiving equipment installed in five Vertol 44s operated by New York Airways and in an H-13H Bell helicopter owned by the Airways Modernization Board.

Military Evaluation

Army has been evaluating Decca for military use at Ft. Huachuca for the past several years but the New York tests will be the first in this country in civil aircraft. Because the evaluation touches on the area of the present U.S.-British conflict over point source (rho-theta) versus area coverage navigation systems, AMB has emphasized that its consideration of the Decca area coverage navigational aid for helicopters does not alter the U.S. position favoring the point source Vortac system for international adoption as the common system aid for fixed wing aircraft (AW Oct. 7, p. 37; AW Oct. 28, p. 31).

Program which officially began on Sept. 9 will extend for two years and cost a total of $869,000 in services and equipment of AMB's three contractors.

The contractors are:

• **Bendix Pacific.** The Bendix Pacific contract calls for installation and maintenance of the four station Decca chain, of five receiving and display systems in New York Airways Vertols of one receiving and display system in the AMB H-13H, and of a similar system in a station wagon to be used in field tests. Aircraft installations include receiver, computer, flight log and decometers (coordinate indicators) for position display.

• **New York Airways.** Bendix-Decca equipment will be carried and operated on all scheduled flights of New York Airways. Flights are between LaGuardia, International, Newark, Teterboro, White Plains, and Stamford airports, and the Manhattan heliport at West 30th Street. Company also will provide office and maintenance shop space for the program plus hangar space and maintenance for the AMB helicopter.

• **Airborne Instruments Laboratory.** This firm, a division of Cutler Hammer, Inc., is determining the technical tests and measurements of the evaluation, will collect and record test data, and will operate the Bendix-Decca equipped station wagon.

• **Bell Helicopter Corp.** AMB H-13H helicopter has been specially instrumented for the test program by Bell Helicopter Corp. both with the Bendix-Decca equipment and with an associated precision approach system of its own development called RAILS—Remote Area Instrument Landing System.

Four transmitter ground stations that make up a Decca chain lay down an overlapping navigational grid that extends with decreasing accuracy for a distance of more than 200 mi. in all directions.

This is done by having the four stations (one called a master station the others the red, green and purple slave stations) radiate continuous wave signals that are phase locked so that the patterns of constant phase between a master and any slave station form a family of hyperbolic lines.

Decca receiving equipment in an aircraft measures between which two of this family of lines the aircraft is—therefore by using the signals from the master and two slaves, determining with a high degree of accuracy the aircraft's position.

Stations operate in the low frequency band between 70 and 130 kc. set out in the form of a letter "Y" with the master in the center and the slaves located from 70 to 100 mi. away. Receiving system displays position data both with a pen that traces the aircraft track on a special chart and on decometers which are meters that display numerical coordinates of the chart position.

Object of Program

Emphasis throughout the program will be on evaluation under existing operating conditions of an area coverage navigation system for helicopter use specifically in the high traffic density New York terminal area. Decca was selected for the test program as the only system operationally available.

Program will be run in three phases:

• **Phase I**—is a 60 day run-in period to familiarize personnel with operation of the equipment. This phase started Sept. 9. Charts on the flight log will not be inked for checking but pilots will be able to follow their route by watching the track of the stylus.

• **Phase II**—will be a six month data gathering period. Signal distortions and other signal conditions will be measured and reduced to punched card form for rapid processing. Day-night and seasonal variations will be analyzed to determine statistical pattern accuracy of the signal under all conditions.

• **Phase III**—Remaining period will constitute an experimental phase to determine the extent to which this type of navigation system will permit integration of helicopters with fixed wing aircraft with both under air traffic control.

Equipment will be operated on all regular scheduled operations of New York Airways helicopters but operation of the equipment or monitoring of the position display will not interfere with operation of the aircraft in accordance with all applicable Civil Aeronautics Administration and Civil Aeronautics Board regulations.

Method of Evaluation

Both pilot opinion and the inked flight log charts will be evaluated. Additionally the AMB helicopter and the station wagon will collect data on signal characteristics throughout the coverage area of the Bendix-Decca chain. AMB helicopter also will investigate—outside the New York density area—problems of simulated approach and landing at heliports.

Included in these tests will be Bell's Remote Area Instrument Landing System which enables a pilot to set coordinates of a desired destination into a small computer, fly to the designated point using the flight log, then make a precision approach using a cross pointer display and "percentage of distance to go" indicator.

Decca system was first used to navigate and position British ships participating in the D-Day landing at Normandy. After World War II as its use was expanded to include aircraft, a subsidiary company was set up in this country to promote the system's use here. Present Bendix-Decca chain is situated on real estate purchased in December 1946 but U.S.-British differences as to the types of navigational aids to be used by fixed wing aircraft prevented installation of the chain until authorization of the present evaluation program.

Navigation Problems

Problems of helicopter navigation were first detailed by the Helicopter Navigation Guidance Group set up by the now defunct Air Navigation Development Board in April, 1952. This group equipped a Marine helicopter with the then available aids and conducted a test program which found that line of sight VHF systems could be used but had many disadvantages, namely:

• **Accuracy.** Errors up to 10 deg. in bearing were encountered by the group.

• **Distance.** Conventionally low operating altitude of helicopters left wide coverage gaps because of line-of-sight limitations of VHF aids.

• **Distortion.** Signals were found to be distorted near or behind obstructions such as hills and buildings.

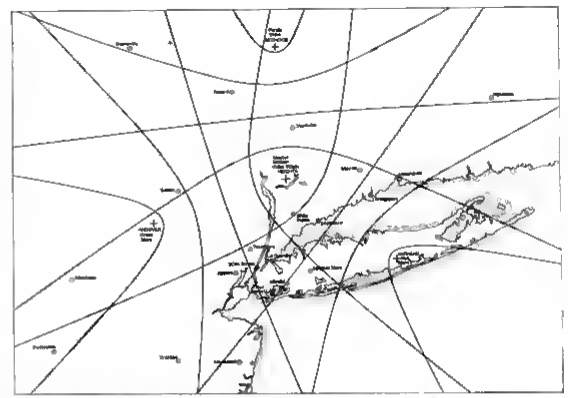
As a result the group recommended evaluation of the only available area coverage system—Decca. Two part program was to be carried out under Army direction, military evaluation at Ft. Huachuca and civil operational evaluation in the New York area.

Formal position of AMB was stated last week by its director, E. R. Quesada.

"The program definitely is not an evaluation of the Decca system for use as a short-distance navigation aid in the U.S.," he said.

"This requirement is already being filled by the Vortac system. The one and only reason for using the Decca system is that it is the only such aid in a state of operational readiness and which could be purchased off the shelf.

"The Decca chain is operating under temporary, experimental licenses issued by the Federal Communications Commission at the request of the AMB. For the purpose of evaluating a hyperbolic type navigation system, we plan to use this one installation for this specific purpose and to discontinue its use when the program is completed."



HYPERBOLIC patterns laid down by four-station Bendix-Decca chain in the New York area are indicated in diagram above. Coverage area of the chain extends with decreasing accuracy to more than 200 mi. in all directions from master station. In area shown, accuracy should be between 25-50 yd. Airports and heliports also are shown.

Space Technology

NASA Plans to Enlarge Wallops For Use as Satellite Launch Site

Wallops Island, Va.—Facilities to permit the launching of satellites weighing up to 100 lb. using Thor, Jupiter or Polaris missiles for boosters will be constructed here over the next several years at the National Aeronautics and Space Administration's Pilotless Aircraft Station.

The $21,250,000 expansion will make Wallops Island—a five mile long, 3,200-acre island which fronts on the Atlantic ocean and hugs the east shore of Virginia—the nation's third major site for launching space probe vehicles. The Station is approximately 160 mi. south-east of Washington and 70 mi. north of Langley Field, Va., site of NASA's principal laboratory.

Wallops Island will not compete with Patrick, the Air Force Missile Test Range at Cape Canaveral, Fla., or the new Pacific Missile Test Range in California for large payload space probes but will provide a convenient experimentation facility where small scale tests can be quickly established and run off without tieing up more expensive facilities at two larger ranges.

The Wallops Island station, originally established in 1945 by the National Advisory Committee for Aeronautics for testing high speed aircraft

and missile designs using rocket propelled models already is devoting 80 to 90% of its effort to space technology.

The majority of approximately 150 models to be fired this year will operate at speeds above Mach 7. Speeds up to Mach 16 have been achieved using five stage rocket combinations.

NACA, which will become the nucleus of NASA, is considering use of six-stage rockets for even higher speeds. Current hypersonic vehicle work includes the following:

- **Hypersonic glide vehicles** of the Dyna-Soar type.
- **Ballistic missiles.** Work includes investigation of new shapes and configurations designed to improve stability, control and/or decrease heating.
- **Anti-missile and anti-satellite** missiles with speeds of Mach 5 to Mach 10.
- **Rocket space probes.**
- **Satellite and space vehicle re-entry** problems. This includes investigation of gas and liquid cooling, materials that absorb heat by ablating or subliming.

Remaining portion of the station's current work is on Mach 2 aircraft. One major program is studying effect of airframe or engine nacelle afterbody shape on jet engine thrust and performance.

Wallops Island plans to conduct tests on the shape and design of manned-capsules for space vehicles and experiments with new high energy fuels in small rocket vehicles, according to Joseph A. Shortal, chief of NASA's Pilotless Aircraft Research Division at Langley.

Defense Obligations, Expenditures Reach Fiscal 1958 High in June

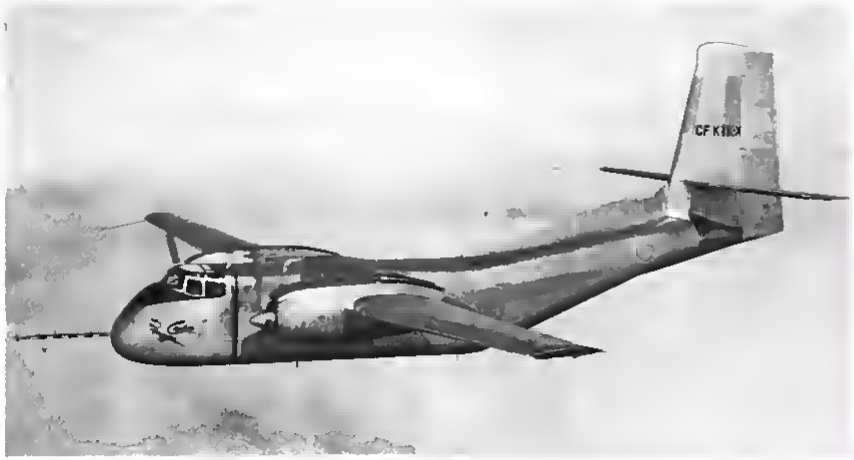
By Ford Eastman

Washington—Defense Department obligations and expenditures for June, final month of Fiscal 1958, reached the highest point for the year, according to the preliminary monthly fund status report released last week.

Defense expenditures for June amounted to $3.8 billion, $345 million more than that for August, 1957 next highest month of the year. Defense obligations for June totaled $6.5 billion which was $1.8 billion higher than obligations in March, 1958 the next highest month. Much of the June increases was normal reflecting accelerated activity in closing out the fiscal year. June expenditures brought the Defense Department total for the fiscal year to $39 billion (AW Sept. 15, p. 26) leaving an unexpended balance of $32.3 billion.

Major items included in Defense expenditures for military functions in June 1958, excluding military assistance, are:

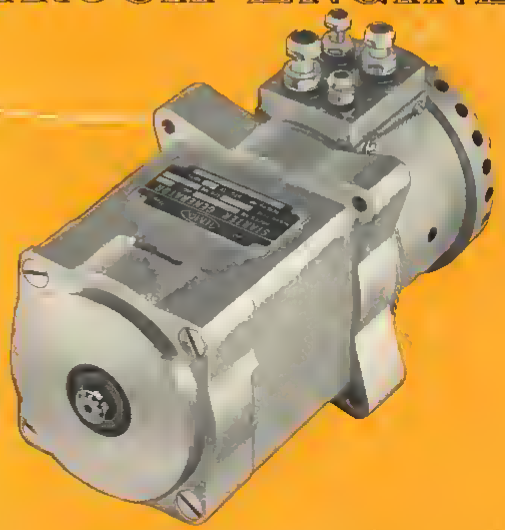
- **Military personnel costs**—$1.060 billion, up $232 million from the previous month and bringing the year's total to $10.4 billion.
- **Operation and maintenance**—$962 million, up $185 million from the previous month, to bring the year's total to $9.1 billion. In this category, there was $11.6 billion available for expenditure, leaving an unexpended balance of $2.4 billion. Expenditures included $345 million for aircraft and facilities in June, $59 million more than that expended in May.
- **Major procurement and production**—$1.5 billion, up $336 million over May, bringing the year's total to $14.6 billion. Available was $35.3 billion, leaving an unexpended balance of $20.7 billion. June expenditures in this category include $834 million for aircraft, up $167 million over the previous month; $329 million for missiles, up $101 million; and $125 million for electronics and communications, up $32 million.
- **Military construction**—$181 million, $65 million above the previous month, making a total of $1.6 billion for the year. Available was $4.7 billion, leaving an unexpended balance of $3.048 billion. Peak month of the year was October, 1957 when $208 million was expended.
- **Research and development**—$191 million, up $35 million to bring the total to $1.7 billion for the year. Available



Caribou Rolls Out

First DHC-4 Caribou STOL utility transport, shown here in flight, was formally rolled out last week by de Havilland of Canada at Toronto. Five Caribous, powered by Pratt & Whitney R2000 engines, are on order by the U. S. Army; two by Canada.

MISSILE PRECISION
for a
MOTOR TRUCK ENGINE



EEMCO
Starter-Generator
Type D-1025
Chosen for
New Turbine
Truck Engine

When one of the largest motor truck manufacturers developing a new type turbine truck engine requested EEMCO to design a starter generator for the engine, it was recognition of the power, precision and reliability that is built into such EEMCO products. Now in an advanced stage of development, this new turbine engine may revolutionize the entire motor truck industry. EEMCO is proud to participate in this type of "revolution."

For years, EEMCO has been a specialist in the design and manufacture of special motors and actuators for the aircraft and missile industry. Now EEMCO's starter-generator Type D-1025 is an example of EEMCO's flexibility in related fields. EEMCO motors or actuators are on the majority of the latest missiles and supersonic military aircraft for these reasons:

1. Sixteen years of continuous experience in research and development, as well as exhaustive environmental and performance testing, assure maximum reliability of all EEMCO products.
2. Ratio of output to weight is extremely high in all EEMCO units.
3. Production schedules are met on time under stringent military specifications that require the most precise tolerances and performance.

EEMCO starter generator Type D-1025 is an example of such precision manufacturing. Scores of other EEMCO products have been designed and produced for special uses. Your inquiry is invited.

SPECIFICATIONS FOR
EEMCO STARTER GENERATOR
TYPE D-1025

Starter performance. Breakaway torque of 220 inch pounds with terminal voltage of 20 volts.
Generator performance. Delivers 40 amps continuously with intermittent peaks up to 80 amps at 28 volts.
Weight. 14½ pounds.

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for research and development was $3 044 billion, leaving $1 3 billion unexpended.

Defense Department expenditures for major procurement and production items and for research and development in June, broken down by services, include:

• **Aircraft**—Air Force, $589 million, up $76 million from the previous month. Navy, $224 million, up $84 million; Army, $20 million, up $7 million. The Air Force ended the year with the largest unexpended balance in this item, $7 181 billion.

• **Missiles**—Air Force, $187 million, $50 million above the previous month. Navy, $32 8 million, up $8 7 million; Army, $10 8 million, up $4 1 million. Air Force unexpended balance for this item amounted to $2.062 billion, highest of the three services.

• **Electronics and communications**—Air Force, $87 million, up $21 million from previous month. Navy, $12 million, up $2 million; Army, $25 6 million, up $9 5 million.

• **Research and development**—Air Force, $74 million, up $9 million. Navy, $53.8 million, up $4 7 million; Army, $62 7 million, up $21 4 million.

Defense Department obligations amounting to $6 5 billion for military functions in June, 1958, brought the year's total to $43 1 billion. The June total was almost the double obligations of the previous month and $2 billion above March, the next highest month of the year.

June obligations by major budget category are:

• **Military personnel costs**—$948 million, an increase of $76 million over the previous month.

• **Operation and maintenance**—$1 1 billion, an increase of $478 million over the previous month but $6 million below April. Of the total, $460 million was for aircraft and facilities.

• **Major procurement and production**—$3.3 billion, up $1.9 billion from May. This includes $1 4 billion for aircraft, $877 million for missiles and $307 million for electronics and communications.

• **Military construction**—$427 million, up $128 million from previous month.

• **Research and development**—$347 million, up $199 million.

June obligations for major procurement and production items and research and development, broken down by services, are:

• **Aircraft**—Air Force, $1 058 billion, up $498 million over the previous month. Navy, $353 million, up $202 million; Army, $24 million, up $4 5 million.

• **Missiles**—Air Force, $539 million, up $402 million, Navy, $90 million, up $57 million, Army, $248 million, up $58 million.

• **Electronics and Communications**—Air Force, $157 million, up $97 million; Navy, $56 million, up $35 million; Army, $93 million, up $27 million.

• **Research and development**—Air Force, $150 million, up $94 million; Navy, $97 million, up $47 million; Army, $83 million, up $49 million.

Vanguard Delayed By Routine Failure

Cape Canaveral, Fla.—Vanguard satellite launching vehicle No. 3 was scheduled for another launch attempt late last week after an unsuccessful attempt earlier in the week.

SLV-3 would be the first Vanguard fired since the launch stand was modified by Loewy Hydropress Division of Baldwin-Lima-Hamilton Corp. to increase ground wind tolerance. Throwback arms hold the vehicle more rigidly, raising the tolerance from 17 20 mph to 30 mph. Modifications also include new fog nozzles in case of fire.

Launch attempt earlier in the week reached the ignition stage but engine was shut off automatically after a few seconds of burning due to a routine failure.

SLV-3 is one of five remaining Vanguard vehicles in the original program. Deadline of Dec. 31, 1958—the end of the International Geophysical Year—for successful launching of a scientific satellite has been lifted from the Vanguard program as a result of the agreement by scientists at the recent IGY conference in Moscow to continue working together under the International Geophysical Cooperation 1959.

SLV-3 contains an infrared cloud cover experiment designed to give a better understanding of heat exchange and weather patterns.

Acceptance tests on the Allegany Ballistic Laboratory third stage engine is expected to be completed this month, and Allegany engines may be used in the last two vehicles. Vanguard currently uses a Grand Central Rocket Co. third stage.

British Ministry Orders NA.39 Tools

London—Britain's Defense Ministry has placed orders for materials, jigs and tools in preparation for large production order for the Blackburn NA.39 strike bomber, but a spokesman for Blackburn and General Aircraft Co. told AVIATION WEEK that the company has no idea what the production requirement is.

Blackburn currently is on schedule with the manufacture of a pre-production batch of 20 aircraft.

High tensile steel is one of the materials ordered which is used more extensively in this aircraft—notably the wing—because of its high speed, low level role.

News Digest

NAA's Autonetics Division has delivered first completed flight control system for GAM-77 Hound Dog air-to-surface missile to North American's Missile Division.

American Bosch Arma's board of directors was scheduled to meet late last week to approve the executive committee's proposed terms for a merger with Northrop Aircraft. There were no indications that two companies have reached agreement on a stock exchange ratio (AW Sept. 15, p. 29).

North American Aviation plans to award more than 20 major avionic system contracts for the B-70 and F-108 programs for which it is weapon system manager (AW Sept. 15, p. 117). J. L. Atwood, North American president, said these contracts will go to larger companies but that they would subcontract out portions to small business. Prospective contractors for major systems have been contacted in 90 cities to establish qualified bidders list, but the company would also accept proposals from firms not on its original bidders list.

Navy plans to install the Bell AN/SPN-10 automatic landing system on all its Midway and Forrestal class carriers if sufficient funds can be found.

North American Sabreliner UTX made its first flight at Palmdale, Calif., last week.

Army is terminating research and development work on the Dart anti-tank missile. Other anti-tank systems which have a higher kill probability, great reliability and are in more advanced states of development are being considered as operational anti-tank equipment. Army spokesmen say these more advanced systems will be ready for service use at an earlier date and at less cost than the Dart. Prime contractor for the Dart is Acrophysics Development Corp.

Successful Atlas Shot

Cape Canaveral, Fla.—Third three-engine Convair Atlas intercontinental ballistic missile was successfully fired some 3,000 mi. from the Air Force Missile Test Center last week. It was the fourth attempt to fire an Atlas with all three engines burning. Eight other launchings preceded the test series.

Airlines May Demand New Fare Boosts

Proposals by United, Delta may touch off requests for a second fare increase before the year's end.

By L. L. Doty

Washington—Proposed tariff changes filed last week by United Air Lines and Delta Air Lines as a means of bolstering gross revenues is expected to touch off another rash of requests for a second fare increase before the end of the year.

The latest action, led earlier this month by an American Airlines move to revise its fare structure, was prompted by the imminence of jet transport service and the strong likelihood that the Civil Aeronautics Board's General Passenger Fare Investigation will not wind up with financial relief for the airlines until late next spring.

Earlier this year, five airlines filed for fare increases ranging from 12% to 15% as the absolute minimum needed to arrest the industry's deteriorating financial condition (AW Jan. 27, p. 38). The Board's response was a temporary rate hike of 6.6% which was condemned by the carriers as "too little and, perhaps, too late" (AW Feb. 3, p. 43).

Discount Eliminations

The proposed United tariff, which closely conforms to that filed by American, seeks to increase revenues by eliminating roundtrip, circle trip and open jaw discounts, reduce the family plan discount from 50% to 33⅓% and eliminate stopover privileges.

Delta came out with a request for a flat 5% fare hike rounded out to the nearest dime and the elimination of the roundtrip discount. Delta has long espoused a fare structure that sets all rates at an even dollar figure.

As in previous cases, requests for fare increases are expected to vary in scope and create a sharp split within the industry as to just what constitutes a good basic fare structure.

The breach, although not yet clearly defined, appears to be the result of differences over the value of discounts and other promotional fares. Recent tariff filings suggest that the larger trunklines are driving for a standardized fare structure with a minimum of discounts, while regional trunklines find a high merchandising value to bargain rates.

Capital Airlines, for example, has successfully introduced a group student excursion fare providing for reduced rates for groups of 25 or more students traveling Saturday and Tuesday between certain cities on its route system. Continental Air Lines has filed a tariff calling for an extension of its first-class family plan to include a fourth day, Saturday. The airline also wants to apply the family plan to a new economy fare and to introduce a family plan excursion rate on its Los Angeles—Chicago route every day of the week.

American has filed objections to both these tariffs and expounded its basic philosophy on discounts in its protest to the Continental tariff filing. In a letter to the Board, American said:

"Discounts—the classic form of discrimination—can and very often do constitute an uneconomic drain upon revenues, with snowballing competitive implications."

Why the Need

Both American and United said the fare adjustment was necessary to the support of the jet equipment programs. United pointed out that its jet program calls for an expenditure of $421 million between 1958 and 1961 with an additional expenditure of $423 million earmarked for the period from 1962-1965.

United asked the Board to accept the tariff filings without investigation and suspension and added that by doing so, "the Board will have taken an important step in the restoring of investor confidence . . ." All U.S. carriers have similar, if smaller, financial problems but at least two regional carriers believe that a volume air transportation market sufficient to create high revenues will be realized only if attractive fares are offered as an inducement to travelers. Such a philosophy is being practiced on an unprecedented scale by British European Airways in Europe.

BEA announced its intention of launching a heavy fare-reduction campaign during the International Air Transport Assn. traffic conference in Cannes, France this week. On its domestic service in England, it has already slashed fares some $5 below first-class rail fares on the Edinburgh, Glasgow, Belfast and Manchester routes.

BEA officials give the impression that they will concentrate on a cut-rate mass travel market with their Vickers Viscounts and Vanguards. According to Vickers-Armstrongs officials, BEA will be able to cut present tourist fares up to 50% and still show a 10% profit on the Vanguards with a 65% load factor.

IATA Traffic Conference

Most industry observers feel that the IATA traffic conference this week will adopt a rate structure involving a wide range of fare differentials (AW Sept. 15, p. 45). Pattern of air travel expected to evolve in the Cannes conference will be one of first-class service with turbojets backed up by a low fare, high schedule frequency service, handled by Vanguards, Viscounts, DC-6s and Convair 330s and 440s.

Fare differentials in the U.S. have existed since aircoach service was introduced in 1949 and were increased with the gradual introduction of family plans, discounts and excursion rates. There is some strong support within the industry for a fare structure that would permit a fare differential based on route productivity and peak season travel.

Such a rate structure, designed to increase revenues on highly traveled routes and boost traffic on lightly traveled routes, was suggested by Dr. Paul Cherington in his report to Elwood Quesada, special assistant to the President (AW Aug. 11, p. 28).

He indicated that first class fares could be increased because a high portion of such travel is business travel and added that some increase in "on peak day coach" fares may also be justified. He added:

"On the other hand, there would seem to be ample opportunity for introducing additional reduced promotional fares, especially those applicable during off peak travel periods."

Northeast Asks Subsidy

Washington—Northeast Airlines last week petitioned the Civil Aeronautics Board for subsidy payments totaling $4 million to offset heavy system-wide losses that have continued to mount since the carrier was removed from subsidy approximately one year ago.

The New York-Florida authority granted Northeast as a means of making the carrier self-sufficient has failed to be of aid and last year accounted for half the airline's loss of $5.2 million, the petition said.

While Northeast has requested subsidy on a system-wide basis, the carrier said that the short haul characteristics and light population densities of its New England routes made subsidy necessary "at least" in this area. The carrier explained that its New England losses have totaled an estimated $4 million since Jan. 1, 1957.

Asking $3.2 million to cover losses from February, 1957, to June of this year and $888,616 for the remaining six months of 1958, the carrier said it has been forced to borrow more than $5.7 million during the past several months in order to meet working capital and net worth conditions of credit agreements signed with the Chase Manhattan and other banks. The last cash advance of $2 million, drawn from the Atlas Corp.—the major Northeast stockholder—in July, left such a narrow cash margin that August financial figures may show the company has exhausted its cash resources, Northeast said.

The airline said recent inauguration of Viscount service is expected to eventually strengthen the carrier's financial status but will cause a heavy cash drain during the initial services, the airline added.



Continentol Airlines Viscount 812

Vickers Viscount 812 is flown in Continental Airlines markings at Farnborough. Continental is buying 15 Viscounts and runs daily scheduled Viscount service on its Chicago-Los Angeles route. Continental Viscounts have been certificated at 69,000 lb. maximum takeoff weight. Manufacturer, however, says weights will be increased by 3,500 lb. to 72,500 lb. and development and flight test program is "well advanced." New Viscount 810s also will be equipped with two slipper tanks of 300 gal. capacity each.

New Traffic Computer Undergoes Final Tests

Indianapolis—Automatic traffic control computer, first of a network which Civil Aeronautics Administration plans to install at all of its An Route Traffic Control Centers, will go into operational use here soon, followed shortly by similar units at New York and Washington. Indianapolis computer is now undergoing shakedown tests prior to its use for day-to-day operations.

Computer accepts and stores flight plan data on all aircraft in the area, calculates estimated time of arrival over each fix, prints out required flight progress strips for traffic controllers, and automatically searches for potential air space conflicts.

CAA plans to order five more computers with Fiscal '59 funds by end of the year for installation at Boston, Chicago, Cleveland, Detroit and Pittsburgh centers (AW June 23, p. 28).

Agency has been experimenting with use of computers for traffic control for over five years and decided to proceed with implementation to obtain experience and relief from pressing traffic control problems without waiting for the more sophisticated system being developed by General Precision Laboratory under Airways Modernization Board sponsorship. Earliest implementation of the AMB GPL system probably could not occur before 1961-62. CAA however, is renting its traffic control computers rather than purchasing them so that it will be in position to switch to AMB-GPL system when it becomes available.

Computer installed at Indianapolis is an International Business Machines Corp. 650 RAMAC, with an IBM accounting machine used to print out flight progress strips at rates up to 3,000 strips per hour. Computers being installed in New York and Washington are Remington Rand Univac file computers.

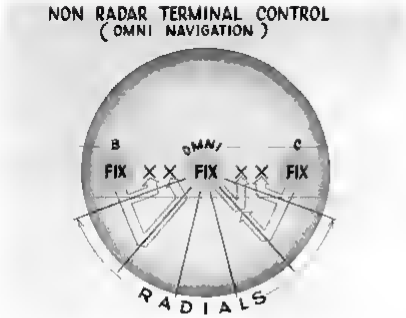
Flight plan data received by voice is converted to punchcard form by electric typewriter while flight plans received by teletype are also converted to punchcard format. Punchcards are carried by conveyor belt to computer room where their information is entered into the IBM 650.

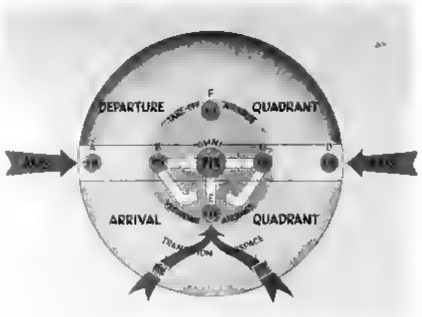
Computer is programmed to accept flight plans along regular airways or off airways. Machine examines new flight plan to determine whether its ETA over each fix along its path coincides within 10 min. of that for another aircraft at the same altitude. When conflict is discovered, computer prints out a "conflict notation" on controllers' progress strip. Controllers communicate with traffic control computer by means of two Inquiry Stations. When airplane's actual time of arrival over a fix differs from its estimated time, controller enters correct time into computer by means of Inquiry Station. Computer then recalculates all subsequent fixes, prints out new flight progress strips for subsequent legs of the flight.

When aircraft leaves the Indianapolis traffic control area, computer punches out flight plan data on cards which are converted to punched tape and automatically transmitted to adjacent traffic control center for entry into its computer.

Capital Reports Delay In Re-Equipment Plan

Washington—Capital Airlines last week reported it is withholding any new re-equipment program for its new Florida route pending the release of the Civil Aeronautics decision in the Great Lakes-Florida case. The Board's press release announcement of the route awards in the Case (AW April 7, p. 41) omitted operating details which the carrier would require as a basis for a revised equipment program. The airline is still surveying the equipment market in keeping with its long-range planning but the program does not necessarily include the addition of DC-6Bs to its present fleet as reported by AVIATION WEEK (AW Sept. 15, p. 35).





OMNIRANGE/omni intersections in transitions and vectoring areas gives flexibility (left). Area to be controlled by ATTAC is at right.

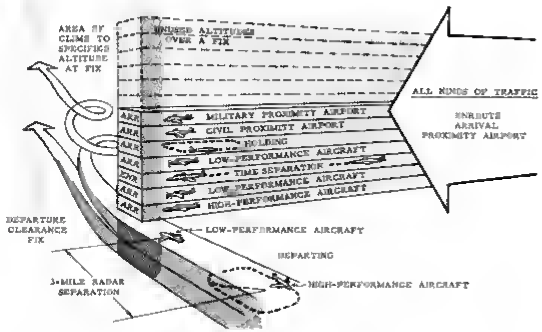
CAA Studies Terminal Air Control Plan

By Robert H. Cook

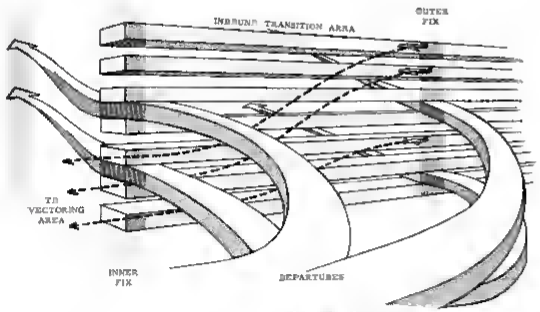
Washington—Civil Aeronautics Administration began an intensive study last week of a new air traffic terminal airspace control plan designed to unravel traffic log jams over major civilian and military airports.

Top CAA officials, impressed with the plan, have asked its originator Joseph J. Remo, vice president of the Air Traffic Controllers Assn. and senior controller at the Washington Air Traffic Center, to carry out a full-time study of the plan as it would apply to the Washington area.

Results of the "paper" study will be evaluated in CAA's simulator program to determine the practicality of its use at individual airports. If the tests prove successful, the system will be placed into actual operation at specified test areas.



PRESENT system of terminal airspace control creates conflict between arrivals and departures.



ARRIVALS are handled in half of 10 to 50 mi. radius airspace; departures in other half.

Smooth Transition

Basically, the plan fills the greatest remaining gap in the common system of air traffic control by providing a smooth transition between terminal airspace and en route and continental airspace control.

The plan hits hardest at the problem of air traffic control delays incurred when arrivals and departures are forced to wait until previous flights vacate assigned altitudes. In particular, the restrictions imposed by the present system of terminal airspace control penalize the maximum flight and economic operation of high-speed aircraft, creating an extra workload and time loss for both the pilot and the controller.

Although it utilizes existing equipment, the system presents an essentially new concept of terminal control permitting an uninterrupted flow of arrivals and departures into and out of a predetermined terminal airspace control area which could encompass several different airports in close proximity. In contrast to present procedures which create conflicting airspace procedures above each separate airport and impose severe altitude and routing restrictions, the plan would place all terminal airspace in a given area under the full control of one terminal agency.

Requirements for the system call for a circle of airspace having a radius of 10 to 50 mi. or more, depending upon the number of airports in the area. Center of the circle would be a point midway between the two most distant airports. Where more than one airport is involved, the plan includes a transition area to include a final vectoring area.

Divided in half by a diameter determined by—and drawn perpendicular to—the final approach course to the airports one half of the circle would be restricted to arrivals and the other to departures with wind conditions for takeoff determining departure direction.

Regardless of changes in wind direction, the system could be reversed 180 deg. so that arrival and departure channels will not conflict. Arrival traffic crosses the path of departures only on the narrow axis dividing the terminal airspace into two halves.

Navigational Fixes

The eye of the circle would be an omnirange station emitting radial signals. Inner and outer navigational fixes would be established along the dividing axis in the transitional and vectoring area as well as in the arrival and departure half of the terminal circle.

Those on the axis would be used as feeders for inbound traffic and routing fixes for departures with definite blocks of altitudes designated where flight paths cross. The fix in the arrival half would be used for aircraft whose inbound flight plan is not in line with fixes on the axis while the departure fix would be used for the same outbound purpose. In addition the plan calls for these aids:

- **Omniranges and intersections** where they may be needed within the airspace perimeter in order to provide more flexible movement of aircraft. The intersections would be particularly useful in terminal areas having no radar equipment.
- **Radar coverage** from the ground to the highest altitude in the control plan, with data being funneled into one terminal control agency.
- **New type navigating beacon** on the axis fixes equipped with oral and visual signals in order to indicate to pilots the time span that an altitude must be held while crossing the path on the axis.
- **Final approach aids** for both directions of the system for each airport involved.

In practice, traffic from the north would approach the outer perimeter of the thermal control area under enroute control to cross the outer fix at a definite altitude on the axis, be identified and then turned over to terminal control. Terminal would then descend the aircraft to the inner fix on the vectoring area where controllers would give the final courses.

Departure traffic would be cleared by terminal control to fixes in the transition area with no necessity for coordination with enroute control except for information such as clearance fix, altitude and time of departure.

Use of flight data and data link display in both enroute and terminal would enable enroute control to plan in advance the movement of departing aircraft in addition to providing a method of reporting altitude availability at a departure fix to subsequent departure traffic.

The equipment would provide a simplified method of coordination between flight data control and ground control.

Until this equipment is made available, an electrical GRS board method of altitude availability to subsequent departure traffic could be provided for terminal control.

Separation Study

In its present form, the system is concerned primarily with attaining the maximum capacity of traffic flow in and out of terminal areas. The study also will consider such matters as proper separation between controlled and non controlled aircraft in the area and the application of positive control procedures to sequence IFR and VFR traffic to a final approach.

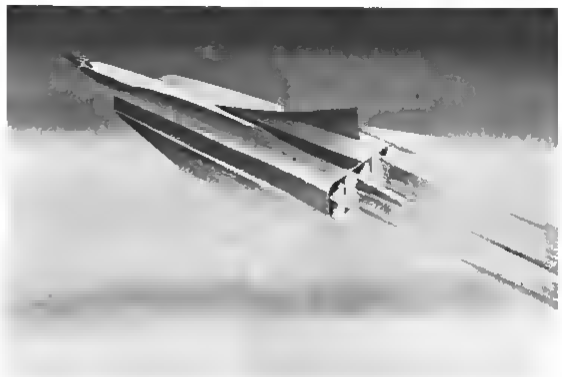
A recent study of 18 aircraft which left Washington National Airport in a one-hour period showed that present traffic control restrictions caused the average plane to average almost 10

Jet Flight Rules

Washington—Civil Aeronautics Administrator James T. Pyle announced last week that commercial jet flights, expected to begin in October, will be ordered to operate under CAA instrument flight rules regardless of weather conditions.

Pyle said that placing the aircraft under definite altitudes and headings prescribed by CAA an traffic-controllers will serve as a safety measure to avoid the possibility of mid air collisions and to compensate for present ground control deficiencies.

He added that while the use of luminous paint to add visibility to aircraft appears to be helpful as an anti-collision measure CAA is not convinced of its practicability because of the expense involved and the lack of proof of its lasting qualities.

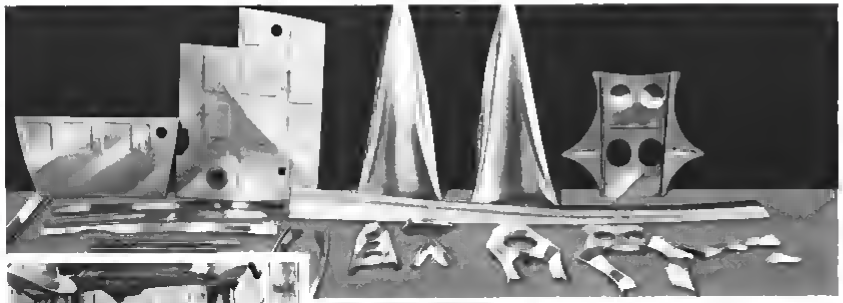


Bristol Thor Romjets Proposed to Power Tronsport

Bristol Aero Engines Ltd. drawing depicts ramjet transport proposed as a suitable vehicle for Bristol's Thor ramjet (AW Sept. 15, p. 31) which powers the Bristol Bloodhound anti-aircraft missile. Parent company, Bristol Aeroplane Co., has no design plans, says ramjet transports are 10-20 years away. The 150 passenger aircraft is designed to fly 2 000 mph. and climb to 80,000 ft. in 15 min. at takeoff. New York-London flight time would be 2 hr.

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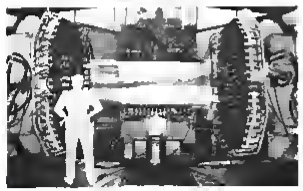


Fabricated Parts
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British Show Tronsport Ground Equipment at Farnborough

Mobile overwing refueling cart (left) developed by Rellumit Ltd., London, for Shell Oil Co. can be operated by one man. It is powered by a Volkswagen power unit and has an automatic electronic device that disengages the clutch and slams on brakes when the upper boom comes too close to any part of an aircraft. Once stop device is engaged, vehicle can be moved only by shifting into reverse. Vehicle has automatic hose connection and hydraulically operated ladder, with fuel meter at top. Antostan Mk. II self-propelled passenger loading ramp (right) has been built for Pan American World Airways' European operations by H. W. Edge hill and Co., Ltd. Power unit is Austin Omni Truck. Stairs are hydraulically adjustable from 8 to 12 ft. heights.

man in reaching altitude of 5,200 ft.

Removal of the restrictions, as proposed by the new plan, would have allowed the aircraft to reach an altitude of 7,500 ft. in the same amount of time, according to its proponents.

ATA Hints Jetliners May Bypass Idlewild

New York—Hint that the jet age could bypass New York if a solution to the noise problem is not found was dropped here last week by Air Transport Assn. President Stuart G. Tipton in a speech at the Wings Club. Tipton reminded his listeners that New York already was bypassed last year by 110 daily passengers using the polar route from the West Coast to Europe.

"This is thoughtful information for a New Yorker," Tipton said. "It may seem to be only a small number, but still it means that 110 people a day did not even think of stopping off in New York to spend money as tourists or to do business here."

Tipton said that the city prepared for the jet age will reap a commercial harvest. "It will be a sadly different story for any ambitious city if it lags behind," he added.

Meanwhile, with Pan American World Airways' initial New York to Paris and Rome schedules set for Oct. 26, the airline began an advertising campaign promoting their service.

Tipton told AVIATION WEEK that ATA considered the Idlewild situation still serious, but that a solution was sure to be found by all elements of the industry working together.

In his address, Tipton paid special tribute to National Air Transport Coordinating Committee, local industry anti-noise group whose technical committee favors the Boeing 707 (AW Sept. 8, p. 39).

The ATA president noted that $10 million had been spent by one manufacturer on noise suppressor development, that the industry will spend $26 million in buying suppressors for jets now on order, and that some $6 million in extra fuel will be spent by the airlines over the next 10 years because of the suppressors. This fuel loss, he said, will be only the beginning of the financial penalty attached to the use of suppressors. Tipton said there must be a national approach to aviation progress and problems.

"There can be no fragmentizing of authority or responsibility," the ATA president said. An airline operator must retain complete operational control of the aircraft at all times, consistent with uniform regulations set forth by the federal government, Tipton contended.

Broker Buys 24 American Convairs

New York—American Airlines last week contracted to sell 24 of its 73 Convair 240s to Frederick B. Ayer & Associates, New York aircraft brokers for lease and resale in the United States and abroad.

Under a tentative schedule, the 24 aircraft—valued by the purchaser at $6 million—will be delivered to Ayer by Jan. 1, 1960, as they are replaced in American's fleet by Lockheed Electra turboprop and Boeing 707 jet transports. Frederick Ayer, president of the Ayer concern, said the transaction was the largest of its kind in aviation history.

Ayer said he planned to sell the aircraft for $225,000 each as anliners or at $385,000 each as converted custom executive aircraft.

He said he intends to dispose of the aircraft by offering lease or lease-purchase plans tailored to individual needs. Permanent Latin American and European sales divisions of his firm will be established.

The Ayer company was formerly known as Trade-Aver but changed its name when it moved recently from Linden, N. J., to offices on Park Avenue in New York.



this nose sees...

Housed in the centre-body of its engine air-intake the English Electric PIB will carry one of the most advanced airborne interception radars in the world. This search-and-track radar forms part of AIRPASS, a complete fire-control system designed, developed, tested, and manufactured by Ferranti Ltd., Edinburgh.

AIRPASS also includes an approach computer and an attack sight. With their aid the pilot can quickly and easily manoeuvre into an attack position, aim his weapons and destroy the target even though he may never see it. If the target should come into view he can continue the attack visually without adjustment of the sight.

At present in production for the PIB, AIRPASS is small enough to be fitted in most military aircraft including lightweight fighters. A complete after-sales service is available, including field engineers, training courses, manuals, test gear, spares, etc.

Airborne Interception Radar and Pilot's Attack Sight System.

- ★ Long-range search-and-track radar.
- ★ Automatic approach and attack computing.
- ★ Blind or visual interception and attack.
- ★ Full freedom of control by the pilot at all times.
- ★ Packaged design for weight-saving and ease of servicing.
- ★ Installation possible in lightweight fighters.
- ★ Simple reliable operation.

AIRPASS

A FERRANTI RADAR FIRE CONTROL SYSTEM

FERRANTI LTD · FERRY ROAD · EDINBURGH 5 · SCOTLAND

SHORTLINES

▶ **AiResearch Aviation Service Division** of the Garrett Corp. has been awarded a contract by Scandinavian Airlines System to handle all ground services of SAS aircraft arrivals and departures at Los Angeles International Airport. AiResearch will handle fueling, loading and unloading of baggage, cargo and mail in addition to interior and exterior cleaning of SAS aircraft.

▶ **Flying Tiger Line** reports a company revenue record during August of $1,150,632, 33% above July, when traffic totaled $866,301 and 42% above August, 1957. Flying Tiger's eight-month traffic revenues are up 15% at $7,295,950.

▶ **Japan Air Lines** total revenue for August was $3,075,000, 40.7% above August 1957. The breakdown of the total figure is $1,036,000 on domestic traffic, $1,989,000 for international routes and $50,000 for charters. JAL's international service earnings showed a 54.7% increase over August, 1957.

▶ **Deutsche Lufthansa** will enter the "deluxe" flight competition in November with the introduction of two weekly flights from Hamburg-Frankfurt-Dusseldorf to New York. The line's Lockheed Super Constellations used in this service will be fitted for only 30 passengers—eight first class seats, 18 "deluxe" seats, four beds and a lounge—compared with 86 seats when flying purely economy class flights. Lufthansa will expand its Middle East service in November by adding one weekly flight from Frankfurt via Munich, Vienna to Cairo using Super Constellations.

▶ **Northwest Airlines** recorded a record in August in revenue passenger miles with 158,107,000, a 19% gain over the 132,845,000 passenger miles flown during August 1957. Domestic revenue passenger miles totaled 123,128,000, up 18.2%, and international revenue passenger miles were up 21.9% to 34,979,000. Northwest carried a record 156,170 passengers on its domestic routes in August, a 12.4% increase.

▶ **Scandinavian Airlines System** reports it will offer a total of 932 million available seat-miles during the winter months, an 11% increase over the comparable period of last year.

▶ **Western Air Lines** reports a total income of $4,515,000 during August, the highest one-month revenue in its history. This exceeds by nearly 7% the $4,224,000 set in August, 1957.

AIRLINE OBSERVER

▶ Three labor groups within Eastern Air Lines have joined in an Airline Council for Trade Union Action to act as a unit when dealing with the carrier. The agreement between Eastern's chapters of Flight Engineers International Assn., International Assn. of Machinists and Air Line Stewards and Stewardesses Assn. is described as not a merger. Purpose is to provide "mutual assistance to any member of the council engaged in industry action or negotiations with Eastern." Chief assistance apparently will be respecting one another's picket lines in case of a strike. Chapters in some other airlines are seeking similar councils. The engineers and mechanics' unions are CIO-AFL affiliates, while the stewards' group is an affiliate of Air Line Pilots Assn.

▶ **Pan American World Airways has advised its pilots that unless the airline and Air Line Pilots Assn. reach a contract agreement by the time trans-atlantic jet service starts, "We will be compelled to fly this service with supervisory pilots." The advise was contained in a recent letter to PAA pilots discussing at length the pay scale and crew complement issues blocking a jet operating agreement.**

▶ Slight improvement in trunkline traffic during August carried over into the first two weeks of September with load factors showing new strength as a result of a level off of available seat miles. Load factor registered in August by the 12 trunkline carriers was 63.16%, highest level reached since August, 1957, when 65.94% was recorded. Revenue passenger miles last month reflected the first increase in four months. However, the increase of slightly more than 1% was insignificant compared to a 17% rise in August, 1957, 15% in August, 1956, and 26% in the same month of 1955.

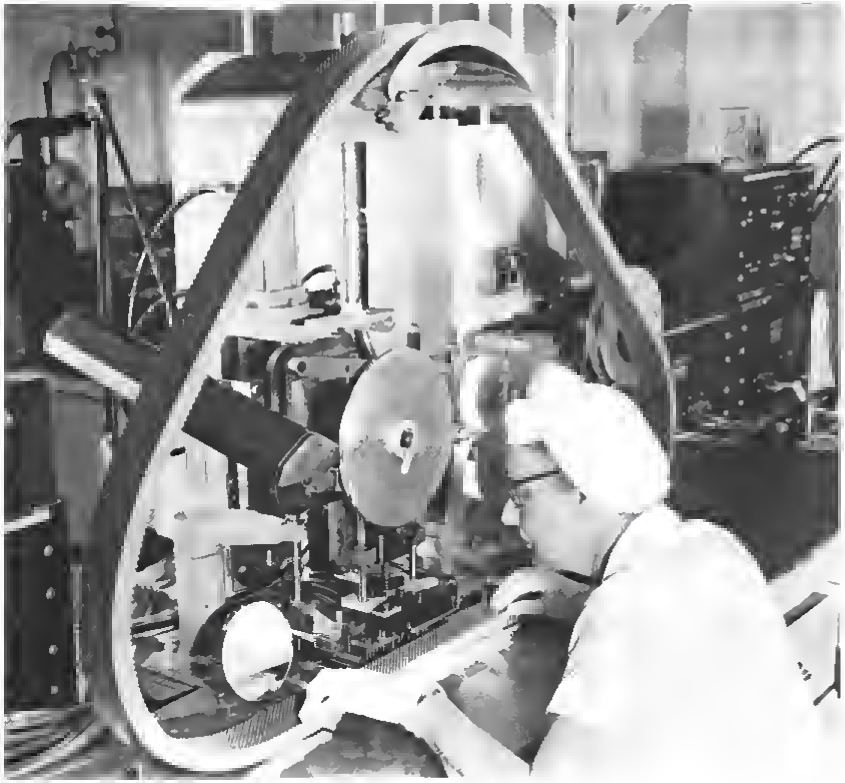
▶ **Pan American-National lease and stock trade agreement (AW Sept. 15, p. 38) could hit a snag if the Civil Aeronautics Board decides to institute proceedings and consider the three-part arrangement as a package instead of separate filings. In such an event, the short-term lease, which would permit National to begin jet service in December, could be delayed by two years at least, the length of time such proceedings normally require. Most airlines can be expected to back such a move, although a growing number of industry leaders are viewing the arrangement as a forerunner to similar deals which some carriers may be forced to take as the only means of coping with the high expense of jet operations and of avoiding the threat of merger. Wall Street looks upon the merger principle as a logical way of bolstering the industry's financial base to justify long-term loans. But the independent character of the average airline management keeps the merger possibility in the background as a last resort.**

▶ White House slowness in naming an administrator to head the recently authorized Federal Aviation Agency is slowly eating away the valuable time gained when Congress pushed the legislation through well ahead of the original target date. White House inaction already has delayed implementation of the act over a month, and the bill is not totally effective until 30 days after the President names an administrator. Indications are strong that Elwood Quesada may be officially appointed to the post sometime this week.

▶ **Latest score on jet deliveries to commercial carriers is 10 jet transports valued at $53.1 million to be delivered to U.S. carriers this year. During 1959, U.S. airlines will take delivery on 77 jets valued at $458 million. Foreign carriers are scheduled to receive five jet transports costing $22 million this year; a total of 51 jets will be delivered to foreign carriers in 1959.**

▶ Pan American World Airways is backing the inauguration of Boeing 707 jet transport service on Oct. 26 with a $1.5 million advertising campaign. First daily flight will leave Idlewild at 7 p.m., arriving in Paris at 8 a.m. and in Rome at 11:20 a.m. All times are local time. The nonstop New York-Paris elapsed time will be 7 hr., 4 hr. and 35 min. less than presently scheduled nonstops.

▶ **Air Traffic Control Assn. has named Stanley L. Seltzer as its executive director to succeed Clifford P. Burton on Oct. 1. Seltzer has been associated with the Air Transport Assn. as an air traffic control specialist since 1951 and was a CAA district supervisor when he joined ATA.**



Solar skills—and unique techniques—produce top-quality all-metal honeycomb structures

PRECISION CORE is a fundamental requirement for top-quality all-metal honeycomb structures. At Solar, accuracy and uniformity are maintained by manufacturing core material on Solar-developed core-welding machines. A result of more than six years of research and development ... the machines produce the core by forming foil-thin ribbons into corrugated strips and welding them together layer by layer. Materials used include PH15MO 17-7PH, T-321, Inconel alloys, L-605, AM-350, AM-355 and A-286. Today, Solar honeycomb is being used in strong, lightweight structural panels for the B-58 and other leading jet aircraft, in gas seals for turbine engines, and in rocket and missile components.

Solar's automatic core manufacturing techniques—*plus advanced panel fabrication and assembly methods*—assure you of top-quality honeycomb structures that will withstand stringent service conditions. For complete information on how Solar's precision all-metal sandwich structures can serve you better, write to Dept. F-68, Solar Aircraft Company, San Diego 12, California.

SOLAR AIRCRAFT COMPANY SAN DIEGO DES MOINES

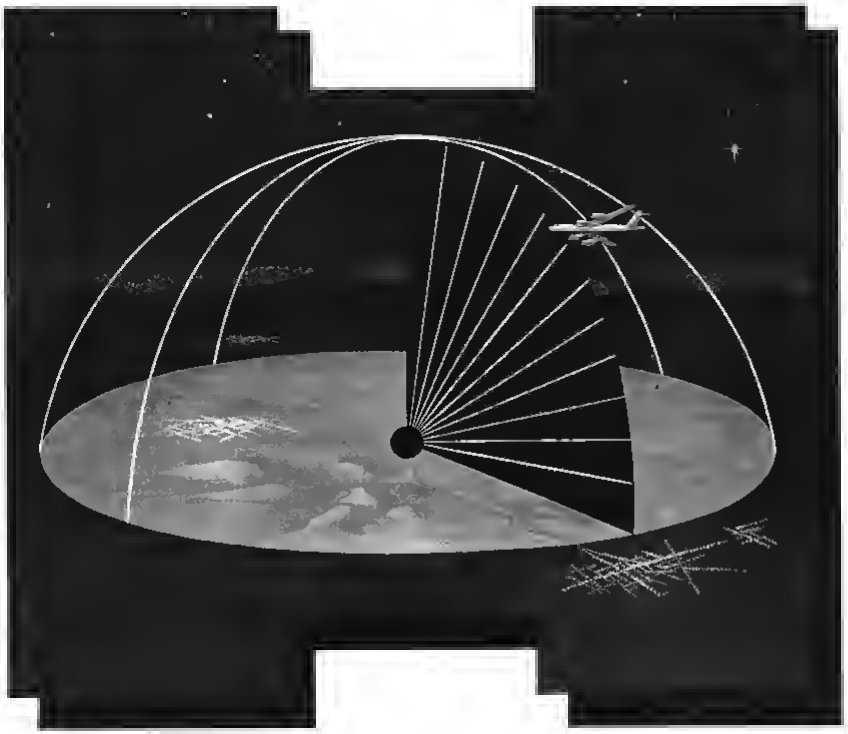
Airline Income & Expenses — 2nd Quarter, 1958

(IN DOLLARS)

	Passenger Revenue	Mail Revenue	Property Revenue	Charter Revenue	Federal Subsidy	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	72,569,776	1,711,934	6,366,598	296,059		81,286,871	72,124,457	10,877,546
Braniff	13,896,705	388,952	778,241	20,279		15,164,436	13,772,656	1,266,575
Capital	25,053,084	614,058	847,075	30,716		26,663,038	25,615,901	760,801
Continental	5,990,675	139,712	276,774	16,719		6,524,442	6,635,906	−425,470
Delta‡								
Eastern	59,339,790	1,008,275	2,403,262	21,113		63,262,860	57,233,514	5,766,395
National	12,311,331	252,988	787,069	173,080		13,703,938	13,504,157	294,060
Northeast	5,320,397	80,840	231,058	39,540		5,719,005	7,374,174	−1,607,486
Northwest	14,885,746	479,639	1,151,223	54,633		16,629,985	15,782,913	656,157
Trans World	51,161,449	1,149,047	2,616,969	62,434		55,811,053	55,083,663	335,822
United	69,732,301	2,473,951	5,021,575	391,488		78,150,404	69,500,823	7,898,264
Western	1,815,088	35,804	62,385	40,992		2,001,599	3,920,561	−1,751,143
INTERNATIONAL								
American	1,216,455	9,160	222,633			1,496,849	1,652,472	−156,850
Braniff	1,603,411	24,078	190,611			1,826,329	2,144,613	−344,102
Caribbean-Atlantic	463,978	6,486	18,594	8,917		519,689	512,613	−5,375
Delta‡								
Eastern	5,374,151	111,934	186,964	209,153		704,474	889,402	−168,563
Mackey	267,304		5,992	4,362		5,882,836	5,351,206	507,066
National	629,501	9,717	58,723	6,446		308,726	353,498	−52,868
Northwest	5,814,824	1,529,766	941,059	130,332		8,606,597	6,776,548	1,864,910
Pan American								
Alaska	718,839	41,669	131,275	34,323		944,089	1,201,525	−46,422
Atlantic	31,596,801	1,843,992	3,215,897	1,090,596		38,573,594	35,164,516	3,517,189
Latin America	15,780,114	519,595	3,896,540	512,568		21,184,944	23,842,097	−2,118,298
Pacific	13,695,579	1,416,359	2,043,188	1,450,042		19,223,441	17,395,273	2,730,967
Panagra	3,152,102	131,685	595,037	169,709		4,581,416	4,754,120	−144,977
Resort				1,628,969		1,664,339	1,531,927	529,054
Trans-Caribbean*								
Trans World	17,582,734	1,478,563	1,030,041	571,417		21,363,587	22,336,461	−1,200,160
UMCA†	14,669		2,624			17,306	25,775	−8,469
United	3,541,775	125,678	72,614			3,779,321	3,133,859	612,231
Western	35,420	265	581	39,497		78,774	252,616	187,565
LOCAL SERVICE								
Allegheny	1,514,384	31,172	63,905	1,258	990,977	2,620,686	2,325,803	274,941
Bonanza	692,518	10,201	19,391	10,271	404,575	1,140,313	1,124,873	14,616
Central	432,596	13,019	19,576	4,180	612,631	1,088,482	1,126,850	−60,456
Frontier	1,123,995	34,425	87,243	5,843	572,949	1,835,305	1,835,083	−5,623
Lake Central	495,693	13,030	17,290	485	446,120	975,619	951,198	14,754
Mohawk	1,650,032	14,138	50,693	15,607	402,769	2,144,573	2,198,846	−126,802
North Central	2,187,303	59,212	52,275	100,782	579,649	2,986,600	3,122,016	−148,035
Ozark*								
Pacific	1,183,026	31,119	25,247	20,345	438,823	1,782,598	1,773,245	−93,193
Piedmont	1,538,841	29,370	46,500	22,972	614,491	2,812,292	2,189,304	122,799
Southern	668,742	22,964	24,392	440	668,269	1,175,151	1,244,587	−75,002
Trans-Texas	858,804	29,514	51,136	28,500	736,191	1,713,329	1,701,768	8,360
West Coast	730,062	12,725	29,152	9,106	403,143	1,181,981	1,222,987	−45,968
HAWAIIAN								
Hawaiian	1,232,800	11,819	192,962	63,242		1,519,892	1,464,260	32,593
Texas-Pacific	557,684	1,747	22,998	26,256	77,103	688,118	604,370	89,768
CARGO LINES								
AAXICO		5,465	127,896	1,506,578		1,672,185	1,772,641	−100,457
Aerovias Sud Americana*								
Flying Tiger*								
Riddle*								
Seaboard & Western		41,785	809,741	3,442,459		8,818,621	8,598,282	285,260
Slick				1,547,994		1,615,421	1,765,903	266,012
HELICOPTER LINES								
Chicago Helicopter	152,574	12,846	1,126	4,087	295,089	466,027	865,811	−16,696
Los Angeles Airways	51,808	34,590	14,753	2,053	230,675	357,246	321,979	15,411
New York Airways	162,039	11,143	12,410	7,080	400,092	606,599	715,361	−117,478
ALASKAN LINES								
Alaska Airlines	493,608	138,846	142,304	264,905	443,982	1,512,035	1,601,821	−6,614
Alaska Coastal	211,917	25,870	35,178	16,486	96,906	396,383	378,121	11,555
Cordova	27,136	24,630	13,216	22,623	91,634	213,568	259,798	−41,133
Ellis	136,943	14,248	20,851	11,930	113,986	301,892	201,213	99,223
Northern Consolidated	195,604	100,945	100,856	30,589	118,165	534,497	597,910	−68,442
Pacific Northern	1,615,854	183,100	257,483	11,738	487,443	2,578,109	2,450,351	86,899
Reeve Aleutian*								
Wien Alaska	219,672	133,685	77,147	249,119	254,097	930,482	918,178	23,638

* Not available. † Urabe Medellin & Central Airways. ‡ Delta Airlines filing fiscal year report in lieu of a second quarter report.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

THE UMBRELLA THAT NEVER LEAKS



To achieve umbrella-like radar protection Hughes engineers at Fullerton, California, have developed systems which position radar beams in space by electronic rather than mechanical means. These unique three-dimensional radar systems are digitally programmed to instantaneously detect high-speed enemy aircraft, even at low altitude.

Other defense systems under development at Hughes in Fullerton are Data Processors which monitor the movement of hundreds of aircraft, store the information and assign defense weapons; radars with beams capable of detecting and tracking missiles; and new radar systems for installation on surface and subsurface naval vessels.

Other Hughes activities are delving into similarly advanced areas of electronics. Engineers at Hughes Research & Development Laboratories are probing into the effects of nuclear radiation on electronic equipment, studying advanced microwave theory and applications, and examining communication on a spatial scale. Applying this advanced type of creative engineering to commercial projects is the task of engineers at the Hughes Products activity.

The highly advanced and diversified nature of Hughes projects offers creative engineers and physicists the opportunity to build a rewarding career in a progressive and expanding environment.



Research & Development Engineers use REAC computing equipment as an aid in such complex problems as systems simulation.



Reliability of the advanced Hughes Electronic Armament systems can be insured only with the equally advanced test equipment designed by Hughes El Segundo engineers.

An immediate need now exists for engineers in the following areas.

Electron Tubes	Radar
Industrial Systems	Communications
Semiconductors	Circuit Design
Field Engineering	Microwaves
Computer Engineering	Systems Analysis

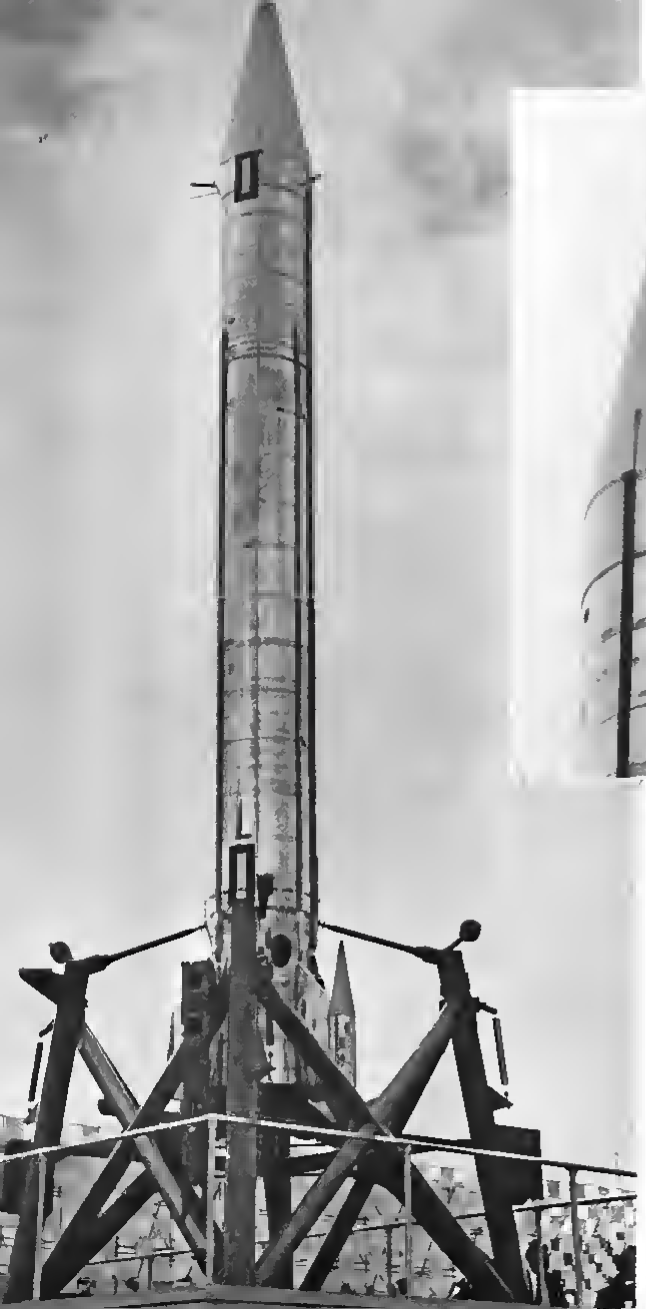
Write, briefly outlining your experience, to Mr. Phil N. Scheid, Hughes General Offices, Bldg. 6-E-1, Culver City, California.

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Creating a new world with ELECTRONICS

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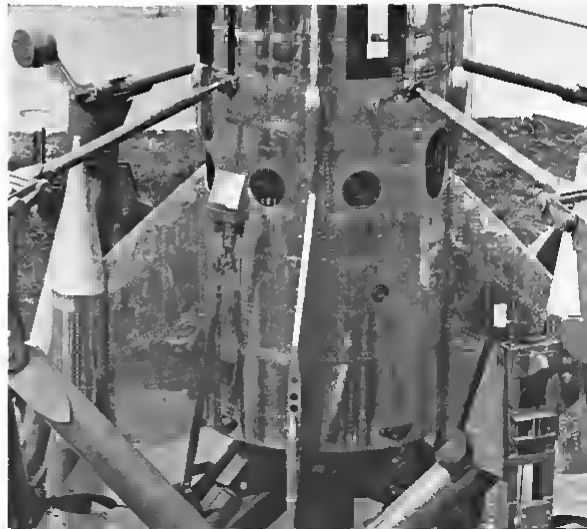
Black Knight launch platform (above) is truss structure of welded tubing. Sway braces, which snap free when vehicle's thrust exceeds weight, extend from tops to half-socket fittings on rocket powerplant section. Powerplant bay (bottom photo) houses four rocket motors, which probably are gimbal mounted. Tension rod at left holds missile down during thrust buildup.

Black Knight Test For ICBM Nose

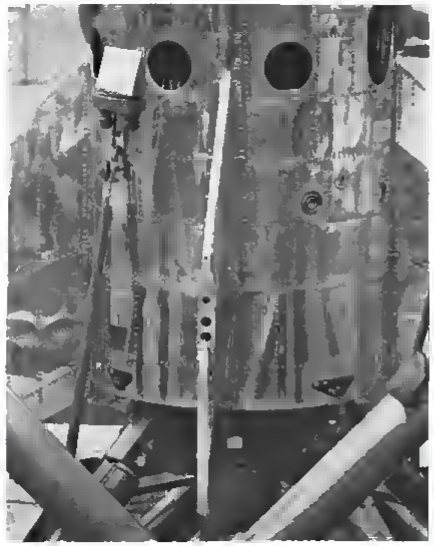
Britain will conduct a series of test flights of its Saunders-Roe Black Knight ballistic re-entry research rocket at Woomera, Australia, range, following successful first firing (AW Sept. 15, p. 33). Black Knight (shown on launch platform at left) is 35 ft. long and is fitted with what appears to be an ablating type nose cone. Two tension cable fittings are visible at the cone base (top photo) to absorb fuselage bending loads and relieve stresses in the thin-walled, pressurized structure. Note single bay of conventional structure below nose cone, and the spot welded and seam welded structure below that. British Ministry of Supply says a variety of nose cones will be used in testing in preparation for firing of the Blue Streak intercontinental ballistic missile. Nose cone from initial

Rocket Designed Cone Evaluation

Black Knight firing was recovered and is undergoing evaluation: note blunt cone on rocket which is on stand and ready for firing (top left photo). Fuel used in first firing was not revealed, however, it is likely the Black Knight's Armstrong Siddeley Ltd. engines were designed for a combination of kerosene and liquid oxygen. Rocket reached a maximum speed of about 8,000 mph but Ministry did not say whether any braking technique was used during the re-entry phase. Actual rise, also not revealed, probably was in the region of 300 to 400 mi. and Britain hopes to reach 1,600 mi. height within 12 months, using a Black Knight coupled with a solid fuel second stage, such as a Skylark. Black Knight was designed and developed in less than 30 months.







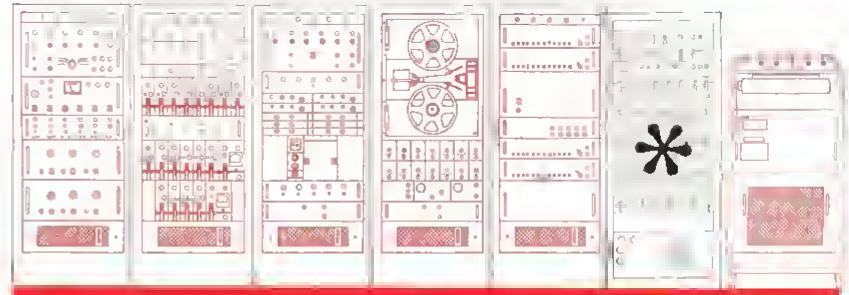
Fins on Black Knight aft section are trapezoidal surfaces of very low aspect ratio. Cone-cylinder shapes at tips of one pair (above) are flares used in optical tracking. Other pair of fins mount what appear to be telemetry antennas. Detail of powerplant bay (right) shows simple fin construction. Wedge is housing for plug for tension tiedown.



Ball and socket joint swaybraces are shown at left and right in above photo of powerplant bay. Note lower ends of spine fairings that run from instrumentation bay just below nose cone, down to top of powerplant section. Second fairing at left (just above access hole) is probably for electrical lines.



One of four stressed cables used to take bending loads and relieve stresses in thin walled vehicle is shown above. Four cables in tension take any bending stresses.



We'll see you at the Airpower Panorama, Dallas, Booth 171

HALLAMORE PHASE-LOCK DISCRIMINATORS

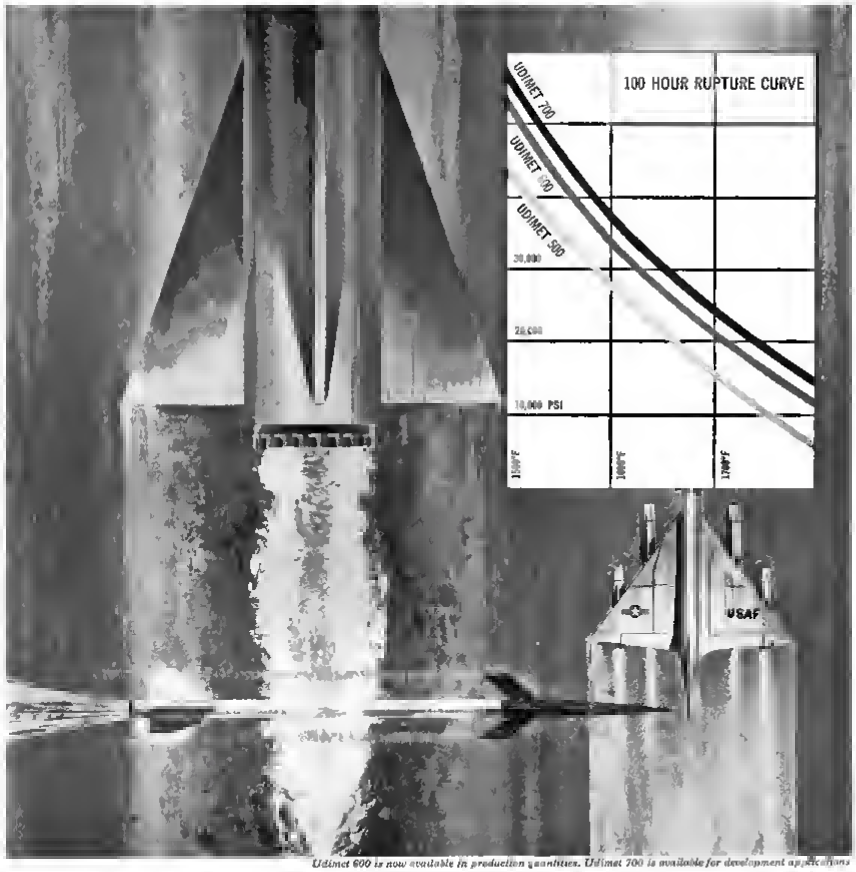
ELIMINATE SYSTEM ERRORS AFFORD ECONOMY AND SPACE SAVING ADVANTAGES—





HALLAMORE ELECTRONICS COMPANY

a division of the SIEGLER CORPORATION



Udimet 600 is now available in production quantities. Udimet 700 is available for development applications

announcing Udimet 600 and 700

for a wider range of applications at elevated temperatures!

The Utica Metals Division of Kelsey-Hayes scores another materials "break through" with vacuum induction melting. Producible only by the vacuum induction melting process, Udimet 600 and 700 surpass the elevated temperature properties of any other known alloy which can be produced in quantity for critical high-temperature, high-stress requirements. They not only possess excellent stress-rupture qualities but also exhibit high tensile strength at temperatures above 1500°F.

Kelsey-Hayes Company, General offices: Detroit 32, Michigan

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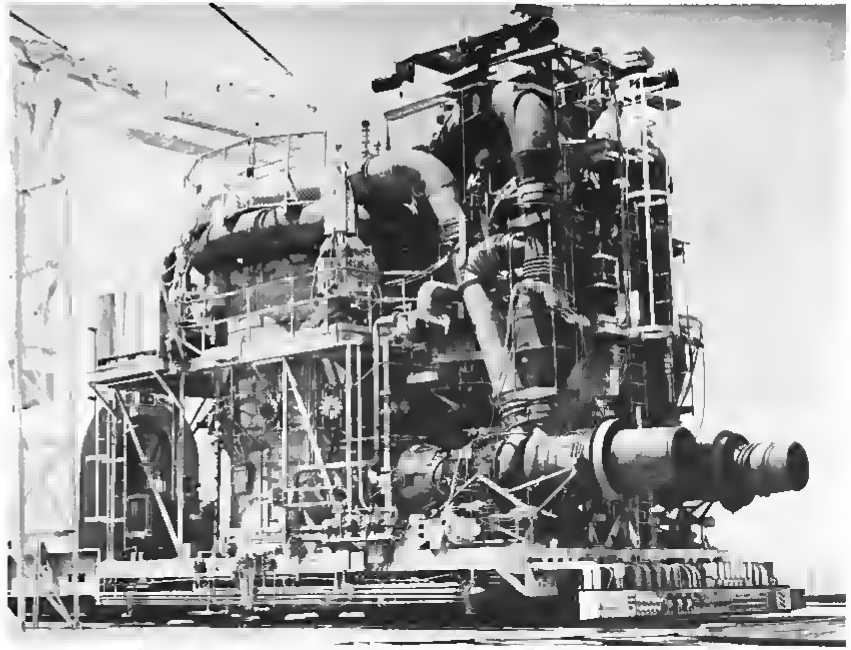
Many vacuum induction melted metals and alloys can now be produced in heat sizes up to 5,000 lbs. by Utica Metals Division.

Some alloys covered by U.S. Patent #2809110

KELSEY-HAYES

Automotive, Aviation and Agricultural Parts • Hand Tools for Industry and Home

18 PLANTS: Detroit and Jackson, Michigan, Los Angeles; McKeesport Pa., Springfield, Ohio (Speco Division); Utica, New York (Utica Drop Forge & Tool Division); Davenport, Iowa (French and Hecht Division); Philadelphia (Gentz Division); Clark, New Jersey (New Jersey Division); Windsor, Ontario, Canada.



HEATED air turns turbine rotors and is exhausted through the engine nozzles. Conventional jet fuel starts engines; after initial start, heated air from nuclear reactor is added until enough is available to permit shutting off the conventional jet fuel

How Nuclear Reactor Powers Turbojet

Details of how a nuclear reactor combines nuclear and chemical energy to power a modified General Electric J-47 turbojet engine have been revealed by General Electric's Aircraft Nuclear Propulsion Department.

D. R. Shoults, department general manager, was to describe the project at the recent International Conference on Peaceful Uses of Atomic Energy in Geneva, Switzerland. His presentation, however, was held up by the United Nations Papers Council because it was judged to lack sufficient technical details. But Shoults' description of the nuclear project at Idaho Falls, Idaho (AW Sept. 1, p. 22) will be included in the final proceedings of the conference.

Shoults said the test project concentrates on:

- **Integrated performance** of the reactor and turbojet engine.
- **Proof that overheating** in portions of the reactor would not lead to local flow starvation and progressive overheating and failure.
- **Demonstration of integrity** and life of key components of the system.
- **Development and demonstration of** ability to carry out extensive remote handling of radioactive components.
- **Control response** of the reactor and its relationship to turbojet engine control.

Heat transfer reactor experimental power plant consists of an air-cooled, metallic-fuel-element, water-moderator reactor operating a single, modified J47 turbojet engine. The engine is located at a distance of several feet from a thick shield in the test assembly. The core, shield plug, control actuators, source rod, startup fission chambers, and operating ionization chambers are combined into an integral unit before insertion into the shield.

The assembly used the direct air cycle in which propulsive thrust is provided by sending atmospheric air from the compressor directly through the reactor, into the turbine, and out the exhaust nozzle.

Air enters the turbojet engine and is compressed to five times the intake pressure. From there it is collected in a scroll and ducted to a manifold on top of the shield tank. Air passes through the shield in a number of parallel ducts and enters the air plenum chamber above the reactor. The air passes through the reactor, is heated, and enters a plenum chamber at the reactor exit.

From this plenum chamber the air returns to the engine, turns the turbine that drives the engine compressor, and then travels through the exhaust handling system.

Entire test assembly is moved by rail

Extreme Temperature Elastomers

Silicone Rubber at 800° F?

We have recently run tests to determine the effect of dry heat aging on silicone rubber at 600°F, 700°F and 800°F. The purpose of these tests was both to establish the upper time/temperature limits of commercial compounds regarded as high temperature compounds and to pinpoint the problems of compounding silicone rubber for extreme temperature use.

Using 50% as the lowest ultimate elongation at which a rubber is considered useful, the life of the best compounds was found to be about 72 hours at 600°F, 2 hours at 700°F and five minutes at 800°F.

In compounding the rubber, selection and quantity of catalysts and fillers used appeared to be quite critical in high temperature breakdown. Highly reactive, quick vulcanizing type gums requiring little catalyst showed better high temperature resistance in our tests than less reactive types requiring more catalyst. Varying the fillers produced different breakdown temperatures.

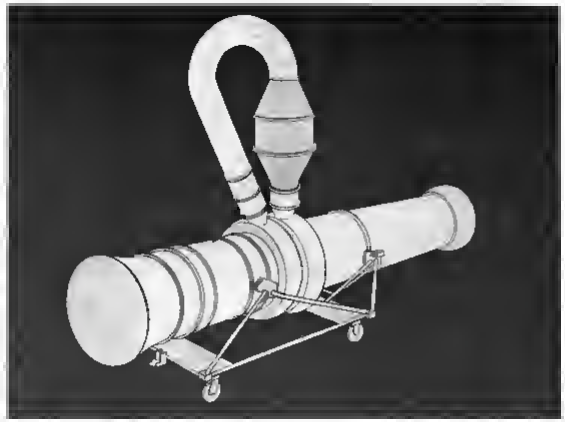
Based on the information gained in these tests, we are carrying out a compounding research program to improve the high temperature resistance of silicone rubber. The results will be published as soon as available.

Conclusion: With proper attention to compounding, silicone rubber still provides better extreme temperature flexibility than any other elastomer. Though disappointing at 800°F the same compounds tested will withstand 500°F for a month or more, 700°F for several hours. They will also remain flexible in the −65°F to 130°F range and provide a shelf life of many years.

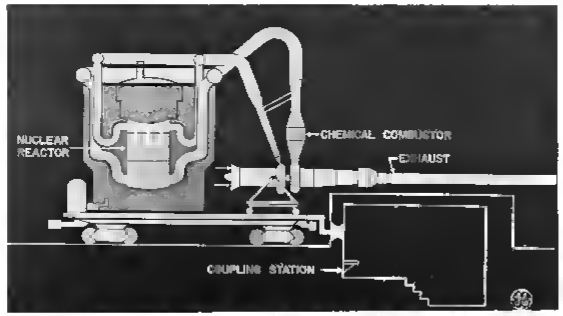
Copies of the tabulated results of our high temperature tests are available for the asking. *Write The Connecticut Hard Rubber Co., 407 East Street, New Haven 9, Connecticut*

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TEST engine arrangement, designated X39 by General Electric, utilizes combustion unit (enlarged section) which draws air from compressor, ducts to rear turbine drive section.



SCHEMATIC diagram shows nuclear reactor in which propulsive thrust is provided by sending atmospheric air from compressor, through reactor, into turbine and out exhaust nozzle.

to an area 6,000 ft. from General Electric's building complex.

Shoults said the engine may be operated on nuclear or chemical fuel, or a combination of both. The chemical fuel is burned in an external burner can, since the space normally occupied by burner cans in the engine is occupied by air scrolls used in ducting air to the reactor. When the engine is operating on chemical fuel, the compressor air may pass through either the reactor or a bypass duct. When operating on chemical fuel only, the engine is controlled by regulating the turbine exhaust temperature.

Reactor power is controlled by the insertion or withdrawal of piston rods, Shoults pointed out. The neutron flux level in the top shield plug is used as a measure of reactor power. The power plant is started on chemical fuel alone with compressor air passing through the cold reactor. As the reactor power is increased, the chemical fuel flow is decreased. When the nuclear power is sufficient for self-sustaining operation the chemical fuel is shut off completely. Engine speed is held constant throughout. Further increases in reactor power will cause an increase in exhaust temperature. Temperature limiters cause scram (emergency reactor shutdown) if the reactor operator allows an excessive temperature increase.

The reactor is air cooled, Shoults continued, and has metallic fuel elements and a water moderator. The reactor core structure is aluminum and consists of a cylindrical water vessel



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penetrated by air tubes. Each of the air tubes contains a fuel cartridge. The air tubes are lined with a thin layer of thermal insulation to reduce escape of the fuel element heat into the water moderator. The shield plug structure and the heavy gamma ray shielding are stainless steel. Moderator water is used for neutron shielding in the shield plug itself.

While a nuclear reactor can in principle deliver an unlimited amount of power, the practical limit on the power that can be extracted from a reactor of given size is imposed by the ability of the system to transfer the heat to the coolant.

The optimum configuration is one in which the fuel elements are all operated at the maximum possible uniform temperature. Three nuclear power distributions must be compensated for to achieve the design performance: (1) the longitudinal power distribution, (2) the gross radial power distribution, i.e., the variation of average power from tube to tube in the transverse plane, and (3) the fine radial power distribution, i.e., the variation of power per unit mass of fuel caused by self-shielding within a single fuel tube. In the No. 1 reactor, satisfactory power distributions were generally achieved, Shoults said.

Test complex includes a "hot shop" where reactor engine components are handled with remote-handling devices. Fuel elements from the reactor core, the engines themselves and engine "hot" parts all were handled remotely.

The heat transfer reactor experiment was concluded successfully at predicted temperatures during the period from September 1956 through January 1957, Shoults continued. Total combined operating time was 258 hr. In this testing the reactor was operated for its scheduled 100 hr. on full nuclear power without failure and without significant leakage of radioactive material into the air stream. The test was terminated when incipient damage of fuel elements was detected.

T53 Passes Stiff Army Service Trials

Lycoming T53 860 shp. helicopter turbine is showing good marks in widely scattered test programs conducted in the field and on the test stand to check the powerplant's capabilities in meeting stringent environmental requirements for use in Army's pentomic division aerial support concept.

Third phase of all-weather test program has been completed at Eglin AFB, Fla. Engine, after cold soaking at −30F, was started and accelerated to maximum power in 43.5 sec. T53 also has been started under −65F conditions. Final test phases will be conducted in Ottawa and Alaska to evaluate a complete helicopter-T53 installation under actual service conditions.

Bell HU-1 (H-40) fitted with T53 was flown cross-country from Ft. Worth, Tex., to Yuma, Ariz., given 50 hr. of severe testing in the desert and then flown back to Ft. Rucker, Ala., for additional trials. The engine which had undergone the 50 hr. of desert flying was returned to the Lycoming plant in Stratford, Conn., where recalibration showed a loss of only 1% in fuel consumption in at full rated power and 2% at 75% power. Prior to field test, this engine had undergone simulated desert trials at Lycoming's sand and dust test facilities (AW Sept. 1, p. 27). Engine ingested 65 lb. of sand continuously over a 25 hr. period, with a resultant loss of only 10% power, not 25% as inadvertently reported. Full engine power was restored after replacement of a few field maintenance parts.

An accelerated 1 000 hr. test program with two T53-powered Bell YH-40 helicopters is underway at Ft. Rucker by Army's Transportation Supply and Maintenance Command. Each helicopter is accumulating 10 to 13 hr. daily. The first T53 engine has already run 150 hr. trouble-free, Lycoming notes. Another T53 ran through 150 hr. on tie-down trials being conducted by Bell as part of a 1,000 hr. tie-down test during which the engine will be run "until it breaks", Lycoming reports.

USAF, Republic Pilots Fly F-105s Over 750 hr.

Republic Aviation Corp. says seven company test pilots and 20 Air Force test pilots have flown more than 750 hr. in the F-105 fighter-bomber during tests being conducted simultaneously at Edwards AFB, Calif., Eglin AFB, Fla., Wright-Patterson AFB, Dayton, Ohio, and at the company's field at Farmingdale, N. Y. The 335th Fighter Squadron, first to be equipped with F-105s, is currently being formed at Eglin AFB.

Westinghouse Delivers T2J Trainer Engines

Westinghouse Electric Corp.'s first production J34-WE-46 turbojet engines have been delivered to the Navy by the company's Aviation Gas Turbine Division in Kansas City, Mo. Engines were subsequently shipped to Columbus, Ohio, plant of North American Aviation, Inc., for installation in the T2J jet trainer being produced for the Navy. Existing $26 million Bureau of Aeronautics contract received last November by Westinghouse covers production of engines into 1960.



KEY OPENINGS IN PRODUCT DESIGN

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Engineers and scientists who would like a personal interview or a prompt report on these or other openings are invited to inquire

C. A. Besio
Supervisor, Engineering Personnel
Dept., M-16

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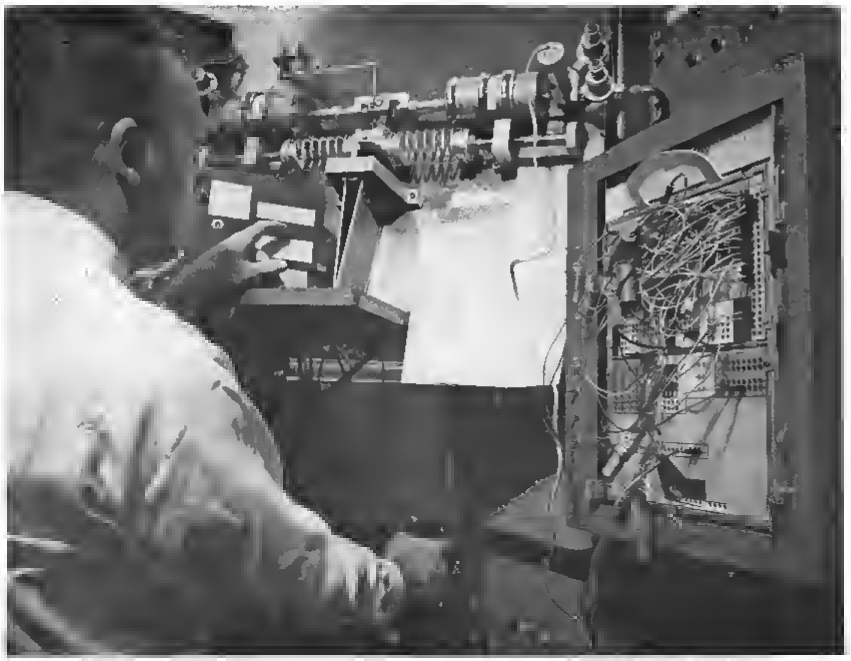
One of the most versatile weapon systems ever devised for America's defense, this new interceptor can fight at altitudes above 95 percent of the earth's atmosphere. It will operate — under all weather conditions — from carrier decks or advanced airbases.

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NOVEL self-adjusting autopilot, which continuously monitors airplane-autopilot performance, automatically adjusts its characteristics to optimize performance under all flight conditions, has been successfully flight tested by Minneapolis-Honeywell.

Autopilot Monitors and Corrects Itself

By Philip J. Klass

Washington—Radically different type of autopilot, which continuously analyzes its own performance and automatically corrects any shortcomings under all flight conditions may revolutionize the design of automatic flight control systems for aircraft missiles and even space vehicles.

New "self-adapting" autopilot techniques could greatly slash the time required to develop flight control systems for new aircraft and missiles. Time consuming flight testing now required to match characteristics of a new vehicle and a conventional flight control system may largely be eliminated if self adaptive techniques live up to present expectations.

The self-adapting autopilot should not be confused with conventional flight control systems that use devices to sense airplane altitude and speed, then change the gain of the autopilot amplifier to match particular cruise conditions. Such gain changers are "crutches" which enable the conventional autopilot to exhibit acceptable performance under most of the anticipated airplane flight conditions but which cannot cope with unexpected situations such as battle damage.

First Radical Change

Self-adapting control techniques represent the first radical change in autopilot design in at least a decade. They open the way to a single autopilot which can provide optimum stabilization on a wide variety of vehicles, ranging from helicopters to supersonic aircraft.

Surprisingly, the new self-adapting autopilots probably will be considerably less complex and more reliable than conventional systems. They should be considerably lighter and smaller than conventional autopilots, perhaps by as much as 50%.

This explains why practically all major flight control systems manufacturers are engaged in research and development on self-adapting flight control systems. The list includes Eclipse-Pioneer, General Electric, Lear, Minneapolis-Honeywell, Sperry Gyroscope Co., Westinghouse Electric Co., Massachusetts Institute of Technology's Instrumentation Laboratory and Acroneutronic Systems, Inc.

Possibly the most advanced stage of development has been reached by Honeywell which has completed 25 successful flight tests of its adaptive autopilot on a Lockheed F-94C. The air

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See diagram lower right


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2


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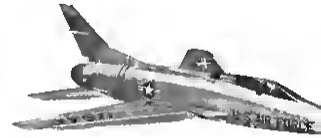

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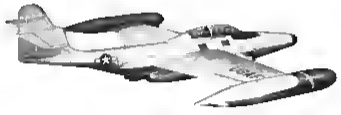

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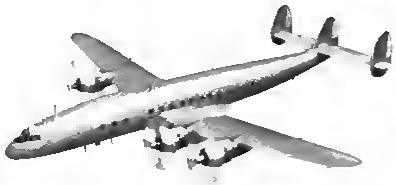


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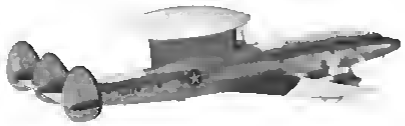


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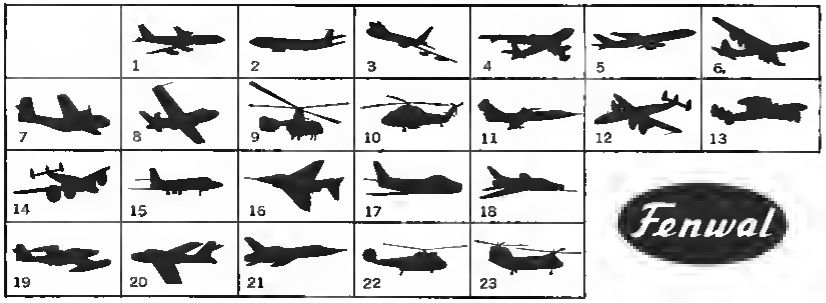
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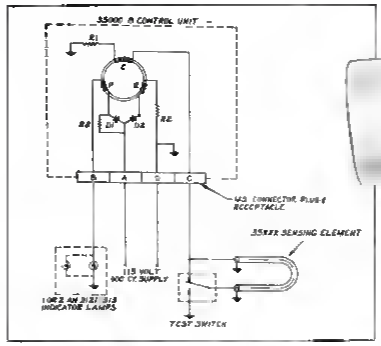




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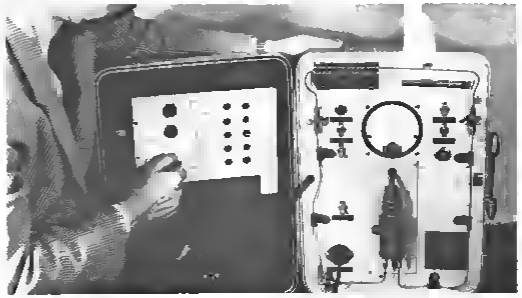
1 Boeing – KC 135 2 Boeing – 707 3 Boeing – B 52 4 Boeing – B 47 5 Convair – 880 6 Convair – B 36
7 De Havilland – DHC-4 8 Douglas – F3D 9 Kaman – H 43A 10 Kamen – HU2K-1 11 Lockheed – F-104A
12 Lockheed – 1049 13 Lockheed – WV-2 14 Lockheed – 749 15 Lockheed – CL 329 16 McDonnell – F4H
17 North American – F 86F 18 North American – F 100C 19 Northrop – F 89D 20 Republic – F-84F
21. Republic – F 105 22. Sikorsky – S-62 23 Vertol – V-107

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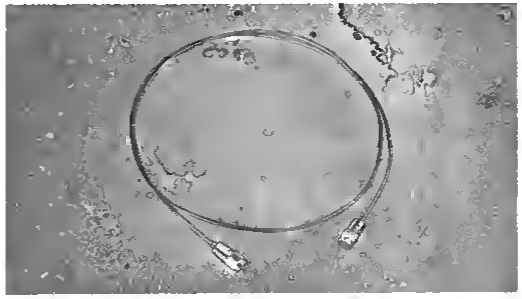




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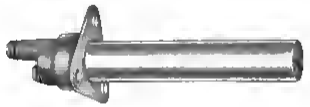
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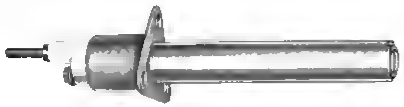
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plane-autopilot combination have performed a variety of acrobatic maneuvers, Honeywell says. The airplane now is at Wright Air Development Center for its flight evaluation.

Credit To WADC

The idea of a self-adapting autopilot, like wishful thinking in any art, is not in itself new. However, WADC's Flight Control Laboratory is credited with having spurred industry interest and activity in exploring possible techniques. (Laboratory plans to launch the program were first revealed by AW (Aug. 6, 1955, p. 27).

At the time, Flight Control Laboratory spokesmen believed that a self-adapting autopilot would probably weigh considerably more than a conventional system and involve considerably more complexity. However, the potential advantages of a universal autopilot, suitable for a variety of aircraft types and flight conditions and the possibility of slashing delays in the development and mating of new autopilot designs made the technique worth at least an investigation, the Laboratory concluded.

With a self-adapting autopilot, it would only be necessary to determine approximate airplane characteristics under boundary conditions and not throughout the flight regime, thereby expediting autopilot development.

WADC therefore placed study and/or development contracts with Aeroneutronic Systems, Cornell Aeronautical Laboratory, M.I.T., Honeywell and Sperry. These called for a fresh look at basic control philosophies and investigation of newly developed nonlinear control techniques.

Out of these programs, and privately financed work by other companies, has come not just one, but a number of different promising approaches and techniques for adaptive autopilots. Flight Control Laboratory is supporting a number of different technique investigations to determine the advantages of each, according to Capt. R. R. Rath who heads up the program.

Long Leadtime

Until the advent of high-speed aircraft, it had been possible for engineers to design an autopilot which could perform well on a variety of different aircraft types. But as airplane designers pushed toward and beyond Mach 1, they were forced to compromise inherent airplane stability. The autopilot engineer's problem was made more difficult by the fact that each type of airplane usually had its own distinctive stability and control characteristics.

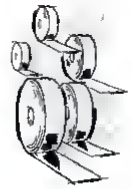
This forced the autopilot designer to make extensive stability analyses before he could design the flight control sys-

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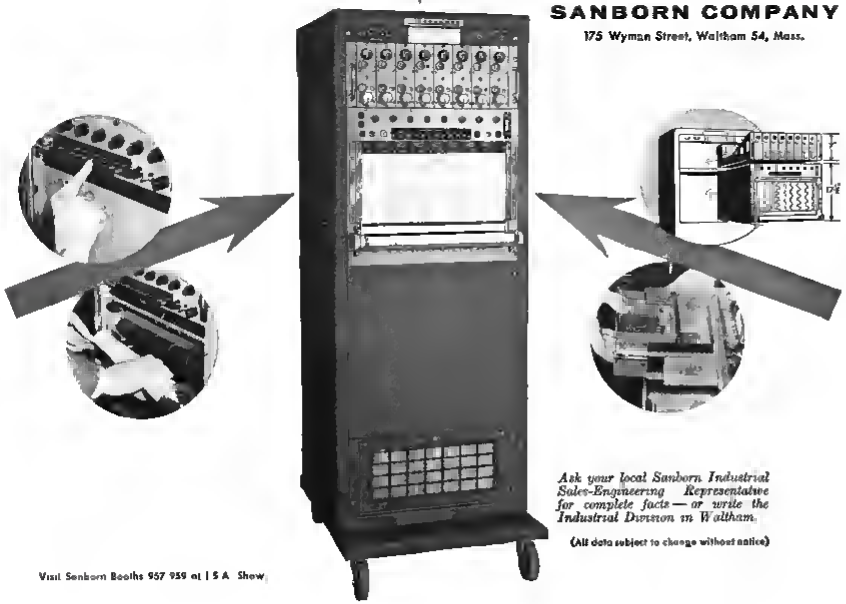
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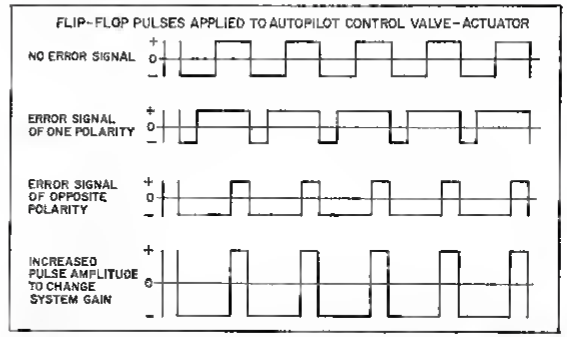
tem, but these analyses could not begin until wind tunnel data was available for the new airplane. When the experimental autopilot was tried for the first time on the first experimental airplane, differences between wind tunnel data and actual airplane performance frequently resulted in incompatibility between airframe and autopilot.

As airplane speeds pushed into the Mach 2 region, the autopilot designer found his problems compounded. In airplanes like the Convair B-58, there might be as much as a 20:1 difference between the control moment produced by a one-degree deflection of control surface at high speeds as at low speeds with similar variations as a function of airplane altitude. The obvious solution was to add devices that could measure airplane altitude and speed, then automatically change autopilot.

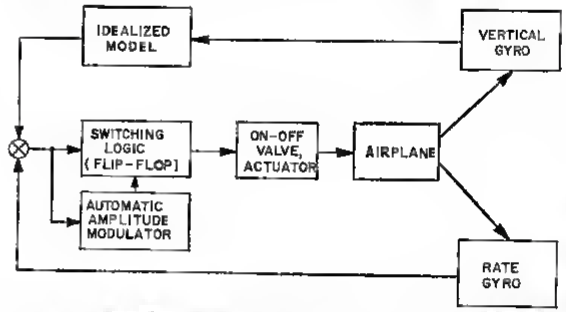
But before such gain changers can be used, it is necessary to determine precisely how airplane control characteristics change as a function of altitude, airspeed and flight configuration. Wind tunnel data gives only a rough clue. The precise answer can be obtained only from flight tests of the actual airplane.

The new airplane must first be flown at speeds and altitudes where it is stable enough for manual control, until the autopilot can be checked out under these conditions. Then begins a tedious, time consuming series of flights at other altitudes and speed while measurements are made and adjustments tried, to determine required parameters for the gain changers. Procedure can involve months of flight testing.

If the first production airplanes have characteristics which differ appreciably



CHARACTERISTICS of pulses applied to control valve and actuator of Honeywell's self adapting autopilot are shown for several error signal situations. Functioning of automatic amplitude modulator is shown at bottom where pulses have increased amplitude.



HONEYWELL self-adapting autopilot uses electric analog (model) of airplane with idealized response, compares this with actual airplane-autopilot performance to determine what changes are needed in autopilot characteristics. Honeywell system also measures actual airplane reaction to continuous control surface oscillation which is too small to disturb human pilot.

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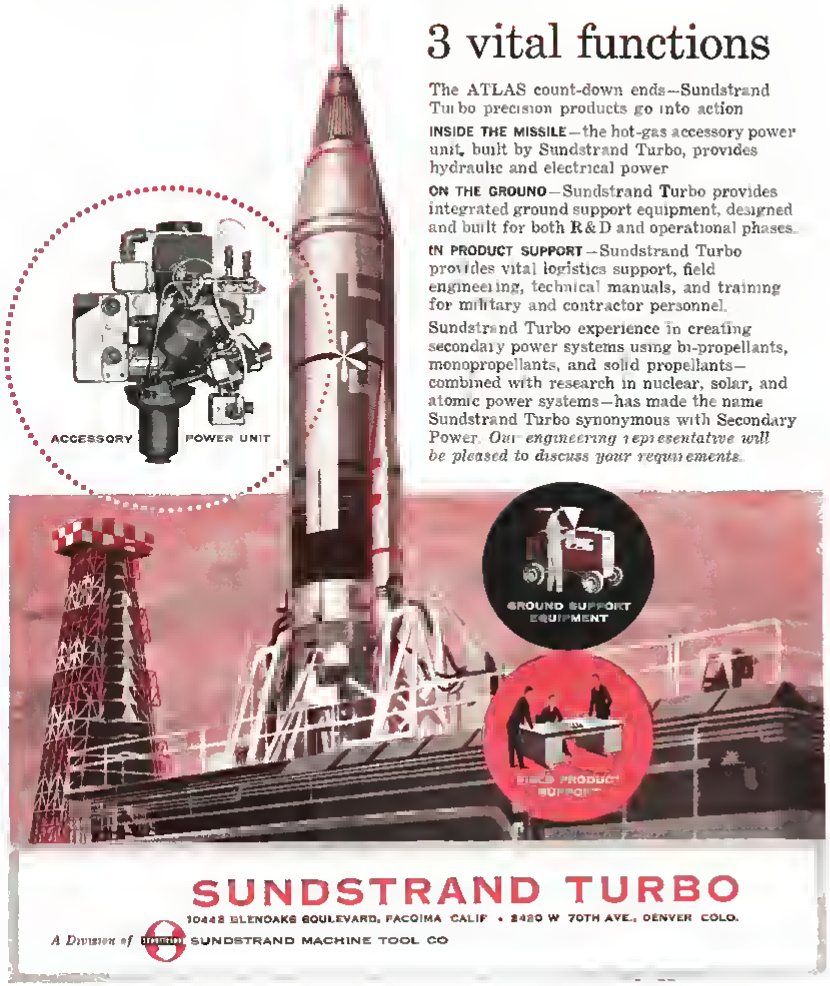
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from the experimental model the whole process may have to be repeated. Many production aircraft usually have rolled out the factory door before a new flight control system design can be frozen. And if the military subsequently decides to add a new external weapon or other change in airplane configuration which changes airplane control characteristics, additional flight testing and autopilot modification may be required.

In sharp contrast, Honeywell's experimental adaptive autopilot was installed on an F-94C and flew the airplane satisfactorily the first time, without human adjustments or gain changers, Capt. Rath says. Another remarkable quality, for an experimental equipment, is the lack of failures during subsequent Air Force flight tests according to Capt. Rath. He attributes this reliability record to the system's extreme simplicity.

Idealized Airplane

Extensive flight test investigations conducted by Cornell Aeronautical Laboratory, using a number of pilots, has provided quantitative data on the control characteristics of an airplane that pilots prefer to fly. For example, human pilots like the feel of an airplane with pitch axis response that corresponds to a natural frequency of about one-half cycle per second with damping factor of about 0.7.

Although hypersonic aircraft do not have such desired flight characteristics over a full range of operating conditions, under manual control the airplane can be made to exhibit nearly ideal characteristics when flown through the automatic flight control system. If autopilot performance characteristics are quickly changed to match changes in airplane control surface effectiveness, the idealized flight characteristics can be maintained over a wide range of operating conditions.

If the flight control system is to be self-adapting, it must continuously monitor its own performance in combination with that of the airplane, compare this with the idealized performance and then automatically adjust its own parameters for best performance.

One way to accomplish this automatic performance monitoring is to incorporate a small electronic analog (model) in the system which simulates the response of an idealized airplane. When the airplane suddenly changes flight attitude, the resulting gyro signal is fed to the electronic model as well as to the autopilot amplifier and control surface actuator. Performance of the actual airplane-autopilot combination is continuously compared with the performance being called for by the idealized model to determine whether any changes in autopilot characteristics are required.

Another basic technique for monitor-



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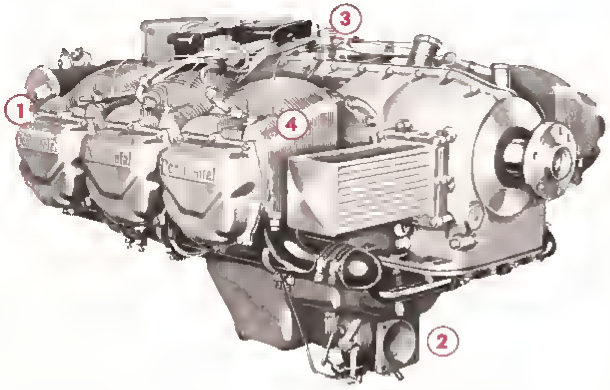
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ing autopilot performance is to periodically introduce a trim signal of known characteristics into the autopilot during flight, then measure actual airplane response to this signal to determine over-all effectiveness of autopilot-control surface combination. Magnitude of the test signal must be sufficiently small that it does not produce airplane oscillation which is noticeable to the human pilot or objectionable for airplane's mission.

Honeywell Approach

For subsonic aircraft where the range of control surface effectiveness ratio is less than 5:1, Honeywell employs the idealized model approach in its self-adapting autopilot. Where the range of airplane control surface effectiveness ratio exceeds 5:1, Honeywell combines the idealized model with a form of the known test signal approach. Both systems employ extremely simple on-off type control of the servo actuator instead of the more complex proportional control used in conventional autopilots.

Under steady state conditions when the airplane is in desired attitude, the flip-flop alternately applies a pulse of one polarity then of the opposite polarity at a rate of about four to six cycles per second. This causes the control surface actuator to start to move first in one direction, then to move back in opposite direction, with no net change in position of the control surface. The amplitude of the applied pulse and its duration result in less than a 0.02G airplane oscillation which is imperceptible to the pilot, according to Louis Wagner, head of Honeywell's flight control projects section.

When the airplane deviates from its original attitude, the resultant gyro error signal causes flip-flop to dwell longer in one position than in the other so that the pulse of longer duration is applied to the actuator for one polarity than for the other. This produces a net displacement of the actuator and its control surface in a direction such as to return the airplane to its original flight attitude.

Polarity of the incoming error signal itself a function of whether the airplane pitched up or down, left or right, determines polarity of pulse whose duration is lengthened and the other whose duration is shortened, which in turn determines the direction of net movement of the servo actuator and control surface.

The error signal which is applied to the flip-flop is the algebraic sum of two signals:

- **Rate gyro signal,** proportional to rate of airplane movement from original attitude.
- **Idealized model signal,** proportional to the rate at which an idealized airplane should respond to a disturbance of the sort experienced by the actual airplane. The idealized model, in reality a small filter network, generates its signal based on the amplitude of airplane deviation from original attitude as determined from the displacement gyro signal which is fed into the idealized model.

At such time as the actual airplane is returning to the original attitude at the same rate as the idealized model is calling for, the net error signal to the flip-flop will be zero and the actuator will remain fixed except for tiny oscillation about its present position. When there is any difference between the actual airplane returning rate and the idealized model rate an error signal will be applied to the flip-flop of appropriate polarity to cause actuator to change position of control surface accordingly.

Amplitude Modulator

With the addition of a simple control circuit the useful range of the simple adaptive autopilot described above can be extended into supersonic aircraft use. This additional control circuit, called the automatic amplitude modulator, continuously monitors the airplane's control surface effectiveness and automatically increases the amplitude (not duration) of the flip-flop pulses to compensate for changes in airplane altitude or speed.

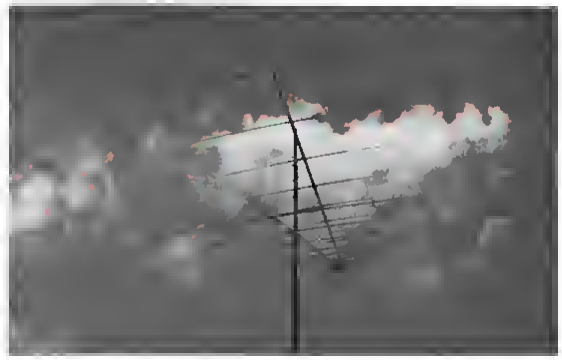
As described previously the control surface actuator is continuously oscillating at four to six cycles per second, producing an infinitesimally small motion of the airplane which is imperceptible to the human pilot—but not to the autopilot rate gyros.

The magnitude of the oscillatory rate gyro signal is proportional to airplane control surface effectiveness. The automatic amplitude modulator compares the magnitude of this oscillatory rate gyro signal with a fixed reference signal, then automatically increases or decreases system gain by increasing or decreasing the amplitude of flip-flop pulses applied to the control surface actuator, according to Boris Boskovich, senior development engineer working on Honeywell adaptive autopilots.

Thus the automatic amplitude modulator performs the function of an automatic gain changer, but without requiring prior knowledge of airplane performance characteristics at each altitude and airspeed throughout its operating range. A time constant of several seconds makes the automatic amplitude modulator insensitive to momentary changes in control surface effectiveness causing it to respond only to relatively steady state changes.

Honeywell's tests and analyses to date indicate that its self-adaptive autopilot will outperform the best of its previous conventional autopilots in all applications considered so far, and that includes hypersonic missiles, Wagner says.

Despite this, the self-adapting autopilot offers significant reduction in system complexity. For example, the conventional Honeywell automatic flight control system for the North American F-100 requires the programming of 15



Broadband HF Antenna

Novel high frequency antenna, which provides unidirectional radiation and impedance which are essentially independent of frequency over bandwidths as great as 6.5 mc to 60 mc, has been developed by Collins Radio Co., Cedar Rapids, Iowa. New antenna, which exhibits voltage standing wave ratio of less than 2:1 over frequency range, employs principle of logarithmic periodicity (AW July 14, p. 75). Present designs can handle 25 kw average power, 50 kw peak power.



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different functions for gain changes each function requiring a small servo system with its motor, potentiometers, and amplifier. The self-adapting autopilot would eliminate all of these, plus the need for an air data computer insofar as the flight control system is concerned.

Another major reduction in complexity stems from ability to use simple flip-flop and on-off servo valves and actuators instead of the proportional types used in conventional autopilots.

Honeywell's studies suggest that the adaptive autopilots reduced complexity will cut over-all system size and weight by 50%, and double reliability (mean time-to-failure) compared to conventional designs. Elimination of altitude-airspeed transducers required for gain changers should also make it easier and quicker to make complete preflight check of autopilot on the ground, Wagner believes.

Sperry Approach

Sperry, which has just completed its WADC sponsored study on self-adapting autopilots with special emphasis on space vehicle applications, uses a slightly different approach than Honeywell, according to Captain Rath.

At periodic intervals, ranging from a few seconds to a few minutes depending upon the airplane's mission, the gain of the autopilot is increased and a brief pulsed signal is applied to the control surface actuator. If the airplane quickly damps out the impulse, the gain is advanced further and the pulse again applied.

When the system gain has been advanced too much, the pulse applied to the actuator will result in a slight oscillation of the airplane. This indicates to system that gain has been set too high and must be reduced slightly. By a continuous and automatic cut-and-try process, the system arrives at optimum gain which will not result in oscillation, Captain Rath explained.

Command signals from the pilot are fed through a model which shapes them on a non-linear basis so that the error signal which motivates the actuator is a function of the difference between desired airplane response and actual airplane response.

Massachusetts Institute of Technology's Instrumentation Laboratory has modified its earlier developed autopilot using rate-integrating gyros so as to make the system self-adapting. An idealized model in the form of an electric analog is used to obtain error signal which motivates the autopilot proportional to the difference between idealized and actual airplane performance, with system gains being adjusted in a closed-loop rather than open loop fashion as in conventional autopilots with gain changers.

Instrumentation Laboratory has flight tested a breadboard model in an F-94 with excellent results, says Captain Rath. Lear, which has designed a transistorized model of the M.I.T. Rath integrating autopilot is modifying the system to incorporate the new self-adapting techniques. The Lear-M.I.T. system is expected to undergo flight testing early next year.

Aeroneutronic Approach

One of the most novel approaches to adaptive autopilots involves the use of statistical correlation techniques to continuously measure the response of the airplane. The technique, under investigation by Aeroneutronic Systems, would continuously superimpose upon the normal error signal input to the autopilot amplifier a source of white noise (random) impulses of low amplitude. Airplane response to this white noise excitation is cross-correlated with input and analyzed to provide quantitative measure of airplane autopilot dynamic response, including natural frequency and damping factor. Any deviation of these values from idealized ones would automatically cause the system to modify its characteristics to optimize performance.

The same technique might, Captain Rath observed, be used also to determine aircraft characteristics from flight test data to reduce difficulty of obtaining aircraft stability derivatives.

Aeroneutronic is designing a digital (binary) noise generator capable of creating constant amplitude pulses of random widths with a magnetic drum used to perform correlation between in



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put and output. WADC hopes to evaluate this next spring in an F-100.

General Electric working with company funds, has come up with still another approach to adaptive autopilots. The company is close-lipped for proprietary reasons, but says its system examines the error signal and by an undisclosed means determines the airplane-autopilot's natural frequency. This is compared with the idealized value to determine automatically how autopilot parameters should be changed to optimize performance.

General Electric has made an unsolicited proposal to Navy Bureau of Aeronautics requesting funds and the loan of a supersonic aircraft to conduct flight evaluation of its technique. Company hopes to obtain BuAer contract.

An Eclipse-Pioneer spokesman says the company is doing some exploratory research and analysis in the field of self-adaptive autopilots. However, he says Pioneer is not presently convinced that self-adapting autopilots can be used in all applications, particularly for hypersonic aircraft.

A Honeywell spokesman, on the other hand, says they expect that most if not all of the systems they propose for new aircraft and missiles will be of the self-adapting variety.

Army Signal Corps currently is preparing a specification for a universal autopilot which can be used in every type of Army vehicle, including helicopters and VTOLs, based on use of self-adaptive principles.

Air Force Office of Scientific Research has just awarded a basic research contract to University of California, Los Angeles, for development of fundamental theory of adaptive control systems with the idea that these concepts may also have application in other than flight control systems.

Whether or not the self-adapting autopilot lives up to all the claims advanced by its strongest proponents, it appears safe to predict that the new technique will have a major impact on future flight control system designs.



Handy Talkie

Miniature portable radio receiver (right) and transmitter (left) provide speedy two-way radio communications, yet are light enough to be carried by man on foot. Units operate in 25-54 mc and 144-174 mc bands. Receiver weighs 10½ to 12 oz depending on whether rechargeable batteries or mercury cells are used; measures 6 x 2½ x 1 in. Unit is fully transistorized. Transmitter weighs less than 3 lb, provides 1½ watts at lower frequency, 1 watt output at higher band. Mfgr: Motorola, Inc., Chicago.

FILTER CENTER

▶ **Computer Designs Transformers**—Time required to design pulse transformers for radars and other pulsed equipments has been slashed from "weeks" to "minutes" using digital computer program, according to Westinghouse Electric Corp.'s specialty transformer department. Given the pulse transformer performance requirements, computer automatically develops all required manufacturing information. Computer programs presently available cover design of transformers with pulse



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New Blaw-Knox 85′ Diameter Tracking Antenna

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Pioneering like this is the latest step in a long series of Blaw-Knox developments. Such milestones as the Guyed Vertical Radiator design in AM radio, the first radar antenna used to bounce signals off the moon, and the Tropospheric Scatter Antenna for over-the-horizon television have marked Blaw-Knox as a world leader in advanced design, fabrication and erection techniques.

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widths of ⅓ to 16 microseconds, average power ratings through 200 kw, turns ratios up to 20:1 and peak voltage ratings beyond 200 kv, Westinghouse says.

▶**Loudmouth**—Compressed air loudspeaker believed to be capable of producing the world's loudest controlled noise is being developed by Radio Corporation of America for determining effect of high intensity noise on avionic equipment performance. Speaker can generate 160 db of noise, 10,000 times as intense as heavy street traffic noise and 20,000 times as great as television set operating at top volume, RCA says.

▶**Look, No Gimbals!**—Lord Instrument is developing a nongimbal pure integration inertial guidance system, under sponsorship of Wright Air Development Center's Weapons Guidance Laboratory. Instead of space-stabilizing accelerometers, they are strapped down to vehicle and measure accelerations in vehicle fixed reference system. Acceleration measurements are then converted to a space-fixed frame of reference by digital computer based on signals obtained from gyros. Lord says it began work on platformless inertial system in early 1950's, but existing state of analog computer art precluded use of technique in airborne applications. Development of airborne digital computers presumably opened the door. Other companies are also investigating strapped-down gimbal-less systems.

▶**Signed on Dotted Line**—Major contract awards recently announced by names manufacturers include the following:

- **Bendix Watch Co.**, Watchbury, Conn., will produce missile launchers for Sidewinder and Sparrow air-to-air missiles under contracts exceeding $3 million.
- **Avco's Crosley Division**, Cincinnati, Ohio, $5 million in follow-on contracts for development and production of prototype units for fixed installation use by Marine Corps.
- **Applied Science Corp. of Princeton (ASCOP)**, three contracts totaling $159,000 from Army and Air Force, for research and development of statistical telemetering equipment. This is new technique for handling high-frequency data on missile aircraft vibration so that data is analyzed in the air vehicle and only significant data is transmitted to ground in order to conserve bandwidth and reduce data reduction time.
- **Beckman Instruments Inc.**, Los Angeles, $150,000 contract from Sundstrand Tmhn division of Sundstrand Machine Tool Co., for electronic system which will monitor pressures, voltages and frequencies continuously on guided missile accessory power supplies prior to launching.

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Any thermocouple material may be made into such multi-conductor cables, or if desired, a cable combining electrical wires and thermocouple wires may be designed to fit your requirements. Cables to withstand environmental conditions of severe temperature extremes, moisture and abrasion are prepared with shielding braid on single or paired conductors as with an over-all shielding. Tell us of your requirements.

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SMOOTH FINISH of Gulfstream's exterior is obtained by using butt-jointed skins throughout, flush riveted. Slight gaps in butt joints are filled with sealer. Main gear is designed to prevent puncturing of integral fuel tanks or to detach without rupture.

Gulfstream Stresses Fuselage Strength

By Erwin J. Bulban

Bethpage, N. Y.—Grumman 159 Gulfstream executive transport design team aimed at fulfilling these performance and structural considerations: fail-safe and safe-life structure; and cruise performance competitive with present and future scheduled turboprop airliners.

Fail-safe and safe-life structural design is aimed at providing a fatigue-free airframe life estimated at some 20,000 flight hours. Rugged design also borrows from Grumman's subsonic and supersonic fighter experience to provide a minimum of maintenance during the airplane's useful life. As an illustration, Gulfstream engineers point out that the integral wing fuel tank system, similar to that used on the company's F11F-1 Tiger supersonic carrier-based fighter, was designed from the start as a trouble-free item for the life of the airframe.

Gulfstream's present 350-mph.-plus design cruise speed with 2,105-eshp. Rolls-Royce Dart R.da.7/2 turboprops is capable of being boosted to well over 400 mph. using future, more powerful engines without requiring dimensional or structural modification. Today's basic airframe has a practical powerplant stretch capability to take engines up to approximately 3,200-eshp. when they become available, Gulfstream engineers told AVIATION WEEK.

Equipment choice was made on the basis of well-proven components consideration being given to attempt to provide guaranteed overhaul time on these items matching those of the Dart powerplants, currently some 1,500 hr.

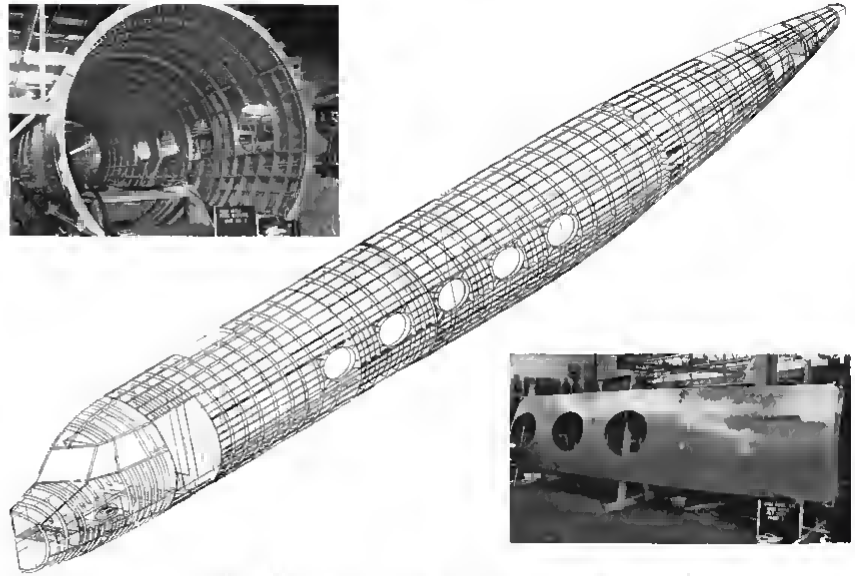
Built-in stairway and auxiliary power plant make the airplane independent of outside ground handling equipment and the 4,000-ft. runway requirement was planned to permit operation at major off-airway points where necessary.

Market Survey

Basic configuration of the Gulfstream was chosen by a design team led by Bernie Harriman. Selection was a result of an extensive market survey of the executive aircraft market, which established parameters for performance and size and showed overwhelming preference for a low-wing layout, Grumman engineers explained. Prior tentative studies also encompassed high-wing configurations, using the basic S2F-1 Tracker anti-submarine hunter-killer layout, powered by piston and turboprop engines. Turbojet power did not figure seriously in the picture because of a lack of proven engines in the range required.

Low wing concept originated in February, 1957, the basic Model 159 configuration being frozen in June. First prototype made its initial flight from Bethpage in August, 1958 and has made over 18 flights including single-engine takeoffs. A second prototype is expected to start flying in October. Grumman expects to have the Gulfstream fully certificated by Civil Aeronautics Administration under CAR Part 4b including SR-422's turbine-powered transport requirements in April 1959. Initial deliveries will be made soon after by the company's distributors who will get airplanes just prior to certification to give them time to furnish and fully equip them to customer's specifications and meet contracted dates.

Fuselage is circular with an outside diameter of 9.4 m. and inside diameter of 8.8 m. Headroom inside the cabin is 7.3 m. without obstructions. Pressurized portion of the fuselage is 41.5 ft. long and includes the cockpit, passenger area and baggage compartment. Nine windows in the passenger area are a horizontal, elliptical type measuring 17.5 m. x 25.5 m., with the exception of two 19 m. x 26 m. windows on each

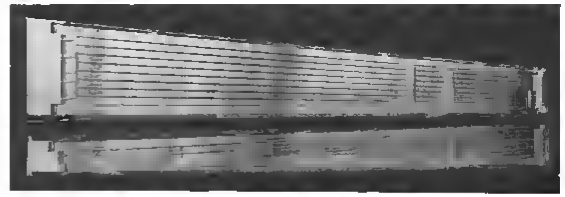


TIGHTLY KNIT STRUCTURE designed primarily for fail-safety also provides long fatigue life airframe. In cabin area, stringers are placed 7.5 in. apart. Skin cut-outs are double-skinned. Window belt (portion at lower right) comprises three panels which are built on jigs.

side which can be used for emergency exit over the wings. Another emergency exit is provided in the roof of the airplane; measuring 20 in. x 36 in., it is located just ahead of the passenger area. Emergency exit windows and hatch are inward-opening to prevent inadvertent blow-out.

Entrance door, just behind the cockpit, is the outward opening type. It is hydraulically operated and contains the integral stairway and railing. Door opening measures 34-in. x 61-in. When locked, the door is held into the fuselage by six bayonet fasteners, two on top and two on each side. Baggage compartment door, measuring 24-in. x 36 in., which can also be used as an emergency exit, opens outward. When locked it is fastened by six pins, two forward, two aft and one each on top and bottom. Bayonets on the passenger door and pins on the baggage entrance are designed to withstand a full load with one bayonet or pin failed. Both doors have pneumatically inflatable seals.

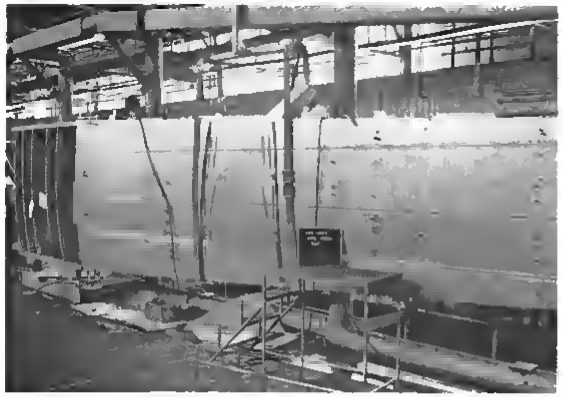
Cabin windows use two .350-in. stretched Plexiglas 55 panes having an air space between them. The inner pane is designed to take the pressure loading, in event of failure, the outer pane acts as a fail-safe member to take the load. Windows are a plug-type assembly installed from inside the cabin,



INTEGRALLY stiffened planks make up the plane's wing covering.



TOP FUSELAGE PANEL utilizes floating frames. Under the frames are riveted straps.



WING INNER PANEL, covered with four spanwise integrally stiffened skin planks which are machined to overlap. Outer wing panels have three plank covers, butt jointed using plates.

a rabbeted edge on the outer panel frame fitting snugly against a similar edge on the 2014ST forged ring retainer. Forging is fail-safe due to it being designed for low working stress having very low crack propagation rate.

Cockpit windshield has V-shaped 1⅛ in forward panels of five-ply (three glass and two vinyl) bird-and-splinter proof construction, electrically heated. Sliding direct vision panels, measuring an inch thick, can be used for emergency escape. Side windows, of three-ply construction, two glass and one vinyl, measure ¾ in thick and can have defogging installed as optional equipment.

Windshield forward centerline post is built of a pair of 2014ST extrusions, a wide structurally continuous .080 in skin and two window retaining angles.

Fail-Safe Makeup

Either extrusion or skin element can fail without affecting the fail-safe axial or bending strength requirement. Splices of the post to the structure at the ends are a fail-safe makeup of splice plates.

Number two posts are similar to the centerline, but end connections are fabricated from back-to-back machined angle-shaped tension fittings, permitting failure of any one tension fitting or its attachment hardware.

On the top side of the upper longeron there is a single fitting bolted to a pair of tension fittings on the post. If the single fitting failed, the fail-safe load path at the upper end consists of the continuous skin element and a residual strength path through the single fitting in which the longeron takes the load across the failed section of the fitting. Number three posts are single 2014ST extrusions with two heat treated 4340 steel plates attached to each and a wide piece of structurally continuous .080 skin. Failure of any one element of the post will not jeopardize its integrity. End splices are also fail safe by using back to back angle-shaped tension fittings. Cockpit windows are held in place using heavy gage aluminum angles on all four sides of the glass. If one retainer failed completely, the other three would carry the load.

Fuselage is built up of six main subassemblies, nose consisting of radome, cockpit and windshield assembly; forward mid-section, mid mid-section, or "doghouse" to which the wing is attached; the aft mid section, the aft section, and tail cone.

Basic structure provides three approaches to provide fail-safe makeup:

- **Redundant structures** are used so that alternate load paths exist if a principal structural element fails.
- **Multi-element structure** provides adequate residual strength if a primary structural element fails.
- **Crack stoppers** are used to limit extent of fatigue damage.

Pressurized area of the fuselage, extending from the forward pressure bulkhead at station 63 (just ahead of the windshield) to the ellipsoidal pressure bulkhead at station 561, is of semi-monocoque makeup, with all skins of 2024ST clad aluminum alloy, chosen for resistance to crack propagation. Frames and stringers are primarily 2014 clad aluminum alloy. Typical frames being channel sections attached to the inside brims of the hat-section stringers. Shear clips intercostal with the stringers, comprise an angle web with

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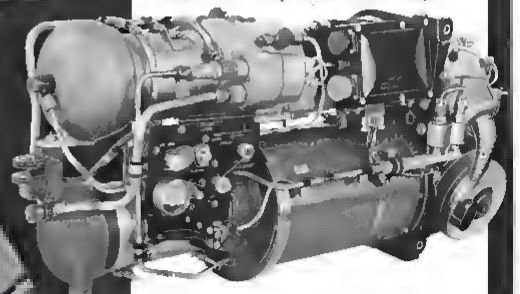
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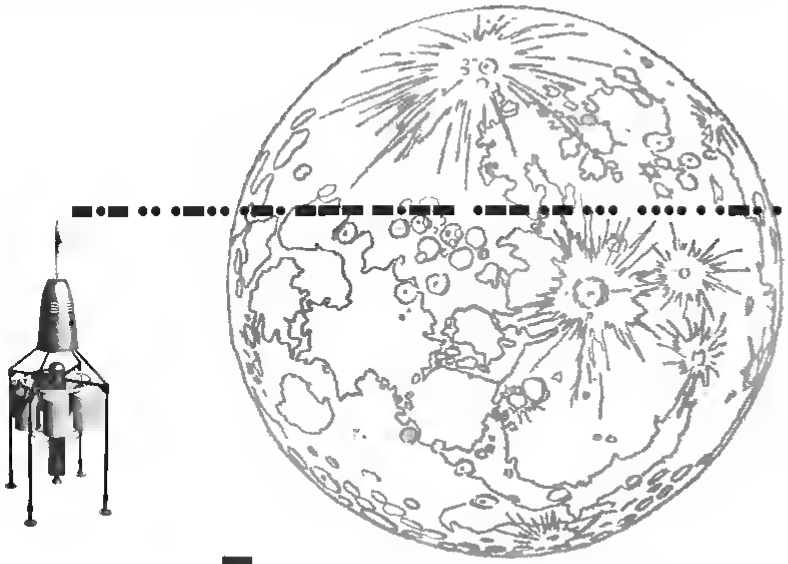
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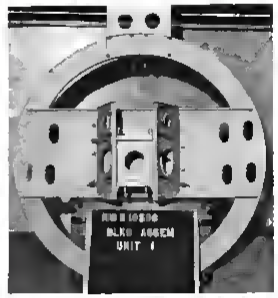
a wedge on it conforming to the skin contour and are riveted to frames and skin, where required.

Forward pressure bulkhead, station 63, is a flat web structure with vertical channel section pressure support beams. Shear web is split horizontally. Gulfstream engineers split web sheets into pieces on bulkheads so that the length of a crack will be limited to the boundary of any one piece. In critical areas of the bulkhead, capstrips, axial load redistribution members and skin shear attachments are multi-element. Pressure bulkhead below the cockpit floor on the outboard sides of the nose wheel well compartment, station 85, is a shear and pressure load redistribution member and also supports the nose gear trunnion. Below the floor the bulkhead is full web of split and multi-web construction having multi-element capstrips. Above the floor it is a multi-element frame.

Closing off the nose gear compartment is a pressure bulkhead, at stations 119-121½, also serving as a redistribution member for shell shears, pressure loads and loads applied by the nose gear. Under the floor it is a full web bulkhead having crack stoppers and multi-element capstrips and shear ties to the skin. Above the floor and over the top of the fuselage it is a multi-element frame.

At the forward edge of the main entrance door and separating the cockpit from the cabin's service area (station 133) is a bulkhead whose primary function is to distribute entrance door pin pressures into the shell.

Left and right sides of the bulkhead are deep beams with multi-element capstrips and with a single web having crack stoppers. Upper part of the side portions is double web; top section over the door is a multi-element frame and the bottom section, under the floor, is a combination of web and truss makeup.



REAR BULKHEAD, station 708, is pickup for rear beam of stabilizer. Slots (left, right) are for determining optimum stabilizer position on prototype.

with multi-element construction. Aft of the entrance door, station 169, is a bulkhead of frame construction with double webs and multi-element capstrips. Left side is a deep web beam with crack stoppers and a web doubler on the upper portion. Also on this side there are multi-element capstrips and multi-element supporting structure for the main entrance door pins. Below the floor the bulkhead is a full depth web beam with multi-element capstrips and web doublers in critical areas.

A frame at station 181 of channel section shear clipped to the skin with additional cap material in critical areas serves as a redistribution member for shell shear and pressure loading around the door cutout. The frame is designed fail-safe for probable types of fatigue, however, it may be completely severed and its loads are then redistributed to a frame at station 193. This frame serves to take the same loads as the frame at station 181, also redistributes shear and pressure loads around the top centerline emergency escape hatch. Top, bottom and left side are channel frames shear clipped to the skin with extra riveted-on capstrip material. Right side of the frame is full web to take electronic equipment installations. This frame may also be completely severed without jeopardizing fail-safe integrity.

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Frames at stations 288.5 and 353 comprise the "doghouse" section to which the wing is attached, and distribute wing loads and moments into the fuselage. These frames are heavy three-inch-deep multi-element box section units attached to the wing beams by machined fittings. Any element of the frames can fail without harming the fail-safe construction. Attachment fittings are not fail-safe but, according to analysis using an IBM 650 digital computer, a complete fitting can be lost with the remainder of the attachment points and supporting structure taking the loads. Fail-safety is maintained by multiplicity of structural ties between wing and fuselage, including four fuselage frame attachments, wing top cover drag angle connections to right and left fuselage skins, drag load connections between wing lower cover and fuselage stringer 22 right and left sides at station 354, shear connections between fuselage skins and front wing beam on the right and left where the fuselage skins cross the beam, and a similar shear connection at the rear beam.

At station 525 is a full-web bulkhead with door cut-out. This member distributes baggage door pin loads into the shell and redistributes shell shear and pressure loads around the baggage door. Member is a full web of single thickness with crack stoppers and multi-element capstrips.

Similar function is served by bulkhead 553, which also is loaded as a compression ring by the aft pressure dome. Pressure dome is suspended from the bulkhead at station 561. Dome tension loads are transferred from the dome-edge outboard to the skin by closely spaced beams spanning stations 553 and 561. Beams apply inward acting kick loads to station 553 bulkhead.

Aft pressure bulkhead measures 35½ in. radius and is mounted inside a varying 3½ in. to 8 in. channel frame attached to the skin. Frame portion receives a series of inward acting loads from the beams between bulkheads 553 and 561, not only transferring dome tension load to the skin but also putting an axial tension load in the frame. Frame also takes loads due to redistribution of shell shear and pressure loads around the baggage door cut-out.

Dome is made from six identical sector-shaped pieces of web having their apex at the dome centerline. From the center of the dome 12 crack stopper straps radiate to the edges and there are two circumferential crack stopper straps. Any panel between crack stoppers can crack and a combination of crack stopper strap plus a web panel crack of half the bay length can be sustained for the fail-safe pressure loading.

Fuselage aft section is similar to the pressurized area with stiffening rings spaced about 18 in. apart and notched at each stringer. A 1¼ in. x .020 in. circumferential doubler, spotwelded to the skin provides continuity across a notch. Fail-safe design of the fin and stabilizer attachment frames allows for loss of any one frame as primary structure and assumes that the bulkhead remains as a fuselage former.

Fail-Safe Philosophy

Fail-safe design in aft fuselage shell considers failure of a frame combined with a fore and aft skin crack exceeding half the frame spacing or about 12 in. long, centered at or starting at a frame. Also covered is loss of a stringer combined with a skin crack averaging about 12 in., extending to the adjacent stringer. Skin cracks along a stringer and between frames can exist up to 15 in. At or near cutouts, a stringer or frame can fail in combination with a circumferential skin crack extending to an adjacent stringer or in combination with a 12 in. crack fore and aft.

Minimum skin gage on the pressure cabin is .040 allowing use of Martin type flush rivets. No spotwelding, bonding or dimpling is used in the pressure area. The use of .040 minimum gage provides a gross hoop tensile strength of 8,450 psi. at 6.55 psi. normal cabin pressure, which reduces crack propagation to a low value, Grumman notes.

Skin splicers are multi-element



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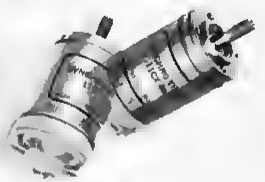
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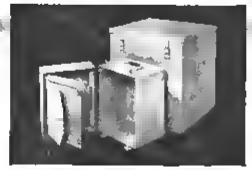
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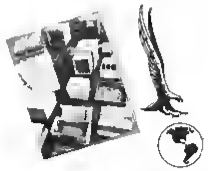
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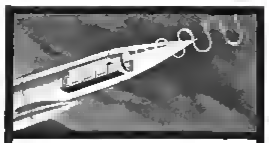
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throughout. This is handled using double splice doublers or a splice doubler and a T-section stringer or frame. In double skin trays, inner and outer skins are lapped and also one or two splice doublers are added across the joint.

Wing of the Gulfstream is of two spar box beam milkup, continuous across the airplane's center line. It comprises a stub center section, continuous through the fuselage and part of the pressurized area, two inner panels containing a total of 10,400 lb. of JP-1 in integral tanks and two outer panels, which contain bladder cells for 300 lb. water methanol.

Wing beams are double webs with multi-element flanges. All ribs have a double flange element with two lines of rivets between the ribs and covers. Mid-section ribs have split webs, in some case a double web for fail-safe considerations. Typical intermediate ribs in the fuel tank section and in the outer panels have single webs with a continuous inner flange past each stiffener cut-out. The dihedral break rib and landing gear ribs have double webs.

Wing covering is composed of integrally stiffened planks of 7075 aluminum alloy machined from stretched plate stock. Four planks make up the wing covering of the inner panels; outer panels are covered with three planks. Typical thicknesses of the panels is .081 at the center section root, top wing, to .034 at the tip; on bottom panels, gage is .064 at root of center section to .034 at the tip. Inner planks overlap, outer panel planks are butt jointed.

Integral Tanks

Integral fuel tank area utilizes sealing system identical to that on the Grumman F11F-1 Tiger supersonic fighter, Gulfstream engineers report. Tank area between the wing beams is approximately 22.5 ft. long on each side of the airplane. To maintain tank integrity, this area is sealed by coating the interior with Buna-N rubber, every detail part being covered prior to assembly. Between the wing beams and plank skin, a single continuous channel is chemically milled to provide a gap which is filled by Thiocol non-curing rubber sealant. There is some 500 ft. of channel sealing per Gulfstream. In the tank area, to joint components 11,950 rivets are installed, all accessible from the outside and each permanently sealed with an O-ring. Each ring is completely submerged in the cavity to provide 100% compression. Adjacent to the channel there is an injection hole placed every six inches to permit putting the Thiocol in under pressure. Holes are covered with removable plugs.

Gulfstream fuel system engineers told AVIATION WEEK that to their knowledge there has been only one case of the



Lockheed Aircraft Corporation, in co-operation with Shell, developed *new fuel techniques* to speed the servicing of the *Electra*.

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FLIGHT photo of Blackburn NA 39 low-level naval strike fighter gives clear view of area rule bulge above exhaust and elongated tail cone which opens to provide speed braking. Aircraft made first public showing at Farnborough Air Show (AW Sept. 8, p. 26)

Tiger experiencing a wing tank leak, this approximately three years ago. Leak was found to be due to improper filling of the channel. Difficulty was fixed in a few minutes, they reported.

Fuel system utilizes four pumps, two in each tank at the inboard sections. All four pumps are operated on takeoff to ensure against fuel starvation, in flight one pump on each side is operated with the other two as standbys. Cross-flow system permits either tank to feed either engine; there is no fuel transfer system from tank to tank. No fuel dumping is provided.

Wing Flaps

Wing flaps are of the Fowler-type, occupying 57% of the span and 30% of the chord. Each flap is single-piece construction, operating on four submerged tracks. There are two mechanical drives on each side, powered by a single motor in the wing center section. System is designed to prevent asymmetric flaps; the jam-proof motor will stop further action if the flaps should fail to synchronize. Tracks, of 4340 steel construction, are designed fail-safe, as is their supporting structure. Flaps can operate even if one track is lost, Grumman reported. Flap action moves the surfaces rearward from 71% of wing chord to 94% of chord. Cams on the rear portions of the two center tracks on each flap automatically droop the surface to 40% full landing position.

Complete Rolls-Royce Dart engine and components forward of the firewall are purchased by Grumman from the powerplant manufacturer and assembled here. Package includes engine, engine mount, firewall, cowling, engine controls and fire extinguishing system. Complete unit is interchangeable with those on the Vickers Viscount airliner.

Jet pipe and tail cone of both engines are identical and interchangeable; the jet pipe being basically of circular configuration and extending to the wing trailing edge to minimize turbulence and provide maximum residual thrust utilization.

Stabilizer is built on a three-cell three-spar box beam of sheet stringer construction with spanwise splices in each cover at the front and center beams. All ribs, except the outboard closing rib, are spliced at the center beam. The outboard closing rib is cantilevered from the fuselage at approximately mid-height.

Stabilizer Design

Fail-safe design of the stabilizer considers these possibilities: attachment fittings of any beam to the fuselage, shear web or cap angle of any beam, the nose "D," either cover between any two adjacent beams, two stringers and 13 in. of skin between any two adjacent beams, or any rib.

Fin construction is similar to the sta



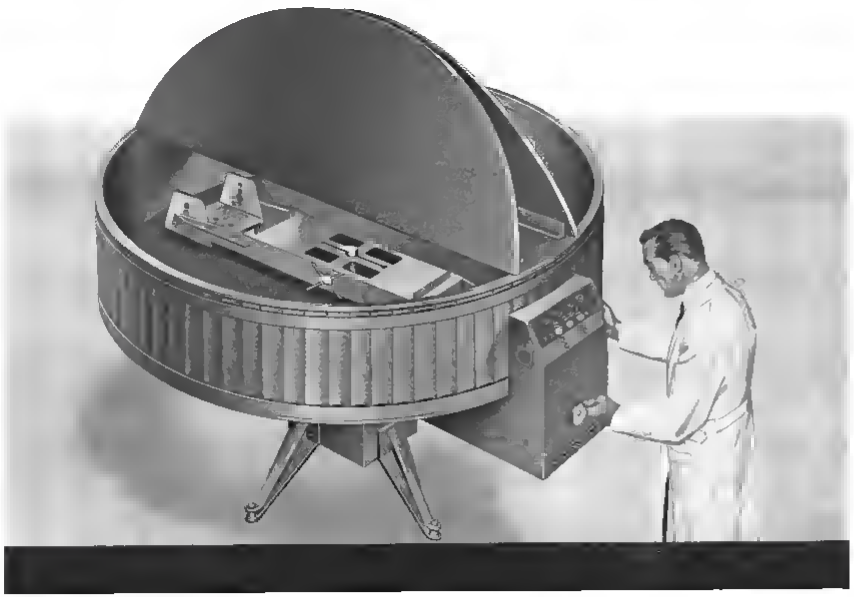
Engine Mishap Causes Dart Herald Crash

Crash of Handley Page Dart Herald at Farnborough Air Show occurred after Rolls-Royce Dart turboprop engine shed turbine rotor blades, cutting fuel lines and causing in-flight fire.

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The building block design concept gives the new centrifuges exceptional flexibility. Machines are assembled from six basic off-the-shelf components, drive system, drive motor, beam, test compartment, console and accessories. You simply select components which provide features needed to meet your specific requirements. Interchangeability of the components permits easy modification as requirements change. Kits are available for modification by the customer.

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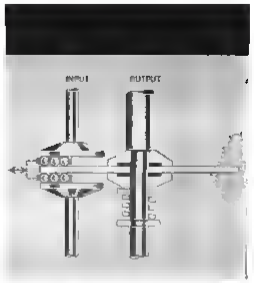
2233 Federal Avenue, Los Angeles 64, California

brief performance specifications



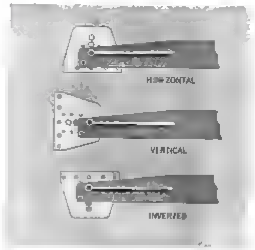
Model No.	Diameter	Test Object Weight	Capacity G pounds	RPM Max.	G Range Max.	Test Object Dimensions
A-1010	20" table	5015 g dead weight	2,500	300	1 to 200 g's	
A-1000	60" arm	10015 dead weight	15,000	300	1 to 350 g's	12" cube
A-1030	90" arm	10015 dead weight	15,000	300	1 to 175 g's	18" cube

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Basket-type mounting platforms, available on Model A-1020 and A-1030, may be oriented from the horizontal to the vertical or to the inverted attitude for multiple-axis testing without demounting the test object. Baskets may be raised or lowered to achieve optimum dynamic balance and minimum angular deflections when extreme accuracies are required. When the basket is inverted the outside surface of the platform may be used to mount bulky, lightweight packages.

Available accessories include additional slip rings, servo control, microwave joints, high pressure air and hydraulic systems, TV viewing systems. Any accessory can be added at any time by the user. The mounting base is standard equipment.

bilizer Control surfaces are conventional in design and are built around a fully manual system Primary control is via bellcranks pushrods and straight cab cable runs the latter being Lock Clad type having a coefficient of expansion close to that of the structure to minimize cable sag Elevator is statically balanced and supported on three steel hinges with a trim tab and balance tab on each surface Two push rods are provided for each tab Elevator tabs are single cell box beams with a honeycomb core designed to be fail safe if any tab hinge is lost

Rudder is statically balanced and supported by three steel hinges and by a thrust bearing at the lower end of the rudder torque tube Combination spring and trim tab is incorporated The spring feature is inactive while the flaps are up

Airport Manager Pay Low in City Scales

Pay scales of airport managers run a mean average of from $12,354 for cities over 500,000 population to $5,092 for cities of 10,000-25,000 inhabitants according to Municipal Year Book for 1958 which covers various phases of municipal operations

In cities of 100,000-250,000 population statistics indicate that airport managers' salaries are lower than those of any other listed city official In municipalities of over 500,000 inhabitants the average airport managers' salary is just above that of the superintendent of streets Figures are based on replies from 129 cities

Regarding appointment of airport managers the year book indicates that on the basis of 182 cities reporting 79 are named by city managers 40 by an airport board 22 by mayors, 18 by a city council and 22 by a department head or miscellaneous official

The year book costing $10 is available from the International City Managers Assn., Chicago, Ill

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From design through final inspection, every detail of Delavan Fuel Injectors receive the meticulous care you would expect to be given to the finest watch.

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Pennsylvania Pilots Form Soaring Club

In an effort to spur gliding and soaring activities in the Delaware Valley area of Pennsylvania, a group of pilots have formed a new association aimed at developing a cadre of enthusiasts who will attempt to build individual club activities around each member

The group will also try to raise official interest from the Civil Air Patrol to process members through a glider course

Delaware Soaring & Powered Pilots Assn will operate from Doylestown (Pa.) Airport, operated by Van Sant Flying Service, which will furnish glider tug aircraft Program will provide trainer and advanced instruction on rental basis, according to the association

Fuel Boost Pump Designed for Bonanza

Addition of an electric fuel boost pump to the Beech Bonanza, aimed at providing pressure in event of failure of the engine driven pump has been developed by Approved Aircraft Accessories, Inc., Detroit-Wayne Major Airport Inkster, Mich.

Designated Boostmaster, the modification comprises an AN4100 Pesco, Ceco, Titan or Chandler Hill fuel pump incorporating pressure relief valves and pressure regulation On Model 35 Bonanza, the unit is mounted adjacent to the wobble pump, on Models A 35 through the H-35, installation is on the left side of the firewall Unit is fitted to the system by removing a short Aeroquip line and replacing it with a preformed aluminum line from firewall fitting to the Boostmaster inlet An Aeroquip line is connected to the booster pump's outlet and the inlet of the standard engine-driven pump Approved Aircraft Accessories reports that its kit provides easier engine starts because of constant fuel pressure to the carburetor in addition to its application as a standby in event of engine-driven pump failure.

Power is supplied by AN standard Pesco, Lamb or Delco electric motors According to AAA, it purchases pump components new surplus and overhauls them in its CAA approved facility, certifying and guaranteeing each unit for 1,500 hr. of engine operation or two years

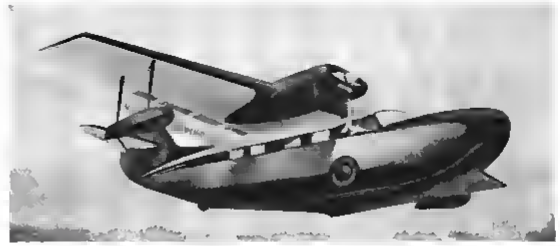


Twin-Jet Paris Delivered to Timken

Delivery of Beechcraft MS-760 Paris twin-jet business aircraft has been made to Harry H Timken of Timken Roller Bearing Co. Aircraft is marketed by Beech Aircraft Corp in U.S., Canada and Mexico under license arrangement with the manufacturer Morane Saulnier Co., Paris France Package price of $210,000 includes pilot transition training MS-760 is powered by two Turbomeca Marboré IIC turbojet engines each with 880 lb thrust Other Timken planes include modified North American B-25 and Beech Bonanza

PRIVATE LINES

Australian entry into lightplane market will be SC-1, which will be manufactured by Southern Cross Mfg Group Prototype is under construction at Toowoomba Foundry, Ltd., at Toowoomba, Queensland Chief designer is N D Hodgekiss, formerly of Handley Page, Ltd., in England Aircraft is all metal, mid-wing monoplane with retractable tricycle landing gear



Lycoming 720s Slated for Goose Conversion

Conversion of Grumman Goose amphibian to be called the Gander is planned around new eight-cylinder geared and supercharged Lycoming GSO-720-A1A engines delivering 520 hp. each turning three-blade Hartzell feathering propellers. Another important modification will be use of large Fowler type flaps to provide improved landing and takeoff characteristics in small areas Artist's sketch of proposed Gander shows flaps extended Plane is expected to have cruise speed of 180 mph., maximum gross takeoff weight of 10,000 lb and maximum water takeoff run of 10 sec Useful load will be approximately 3,800 lb Fuel system will be cross-feed pump type of 330 gal. total capacity, boosting range to some 1,000 mi. Cabin will hold eight passengers. First Gander is expected to be ready for delivery early in 1959, with basic price for outright purchase being $125,000 on basis of trade-in for conversion, customer will get $40,000 allowance Project is by Dean H Franklin Aviation Enterprises, Inc., 3923 N.W. 24th St., Miami, Fla

AERO-SPACE PROPULSION

Openings for *aero-physicists* and *engineers* at Fairchild Engine Division on Long Island, New York. Facilities include *Gas-Turbine Laboratory* and *Advanced Research Laboratory*.

Work is in advanced air-breathing *propulsion systems*, and special applications of *turbo machines* in advanced aircraft and space systems

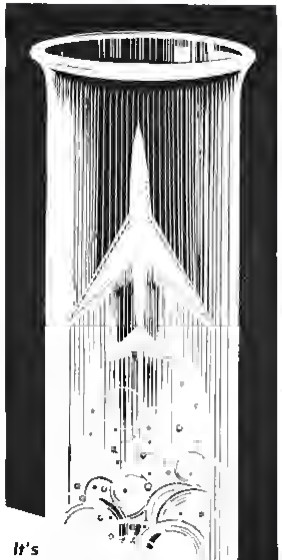
Positions now open require creative thinkers with ability to translate theoretical concepts into feasible systems.

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- **Aeronautical or Mechanical Engineers**, preferably with MS degree and 1 to 5 years of analytical work in aircraft or space propulsion systems with trajectory and mission analysis experience
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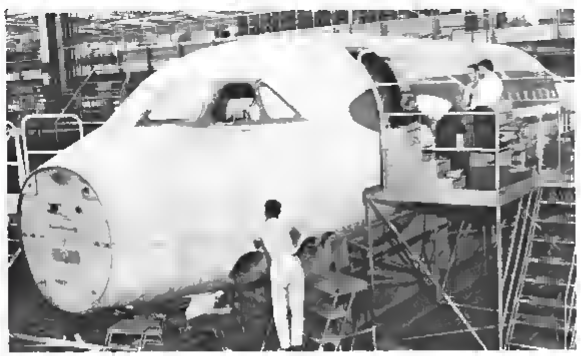
and is powered by 180 hp Lycoming engine.

Reduction of customs charges for private planes clearing U. S. and Canadian customs through North Dakota international airports is being studied by the state aeronautics commission. Charges average from $8-40 on holidays and Sundays (when customs offices are not normally open). Last year 1,566 private planes cleared nearly 5,000 passengers into the state from Canada. One approach the commission is studying is the possibility of building additional private plane airstrips adjacent to regular automobile customs entry stations. One such facility, staffed by U. S. and Canadian officers, is located at Noonan Border Airport.

Winner of recent midget racer contest, Ft. Wayne, Ind., was Tom Cassutt, Huntington, N. Y., flying 525-lb. mid-wing Cassutt Special II, at 195.80 mph. 12 laps of a 2¾-mi. course, beating Steve Wittman and William Falck. Meet was largest since 1952, with 14 midgets (190-cu.-in. displacement engines) competing for $7,500 in prizes. Professional Race Pilots Assn., which sponsors races, elected new officers: James Miller (Ft. Wayne), president; Steve Wittman (Oshkosh, Wis.), vice president; William Falck, secretary and Gordon Stoppelbein (Rochester, N. Y.), treasurer.

First authority granted by CAA for overhaul of Pratt & Whitney Aircraft J57 turbojets has gone to Pacific Airmotive Corp.'s Burbank, Calif., Division, supplementing ratings base holds for handling jet engine accessories. Base already has contract from Continental Air Lines to overhaul its Boeing 707 engines. Pacific Airmotive has overhauled over 350 military J57's also is working on more powerful Pratt & Whitney J75.





Convair 880 Fuselage Sections Assembled

Five Convair 880 turbojet transport aft fuselage sections are in assembly fixtures at San Diego plant of Convair Division of General Dynamics Corp. (Background, top photo). Fuselage section in foreground of top photo has been removed from fixtures prior to mating of wing and fuselage next month. Bottom photo shows first 880 forward fuselage section removed from assembly fixture and placed on a holding cradle. Detail work on this section will continue until it is ready for major mating next month. (See AW Sept. 15, p. 92 for photos of 880 cockpit mockup.)

Horton & Horton, Ft. Worth, Tex., aircraft interior specialists, will work on four Fairchild F-27s, with first plane going to Bank of Mexico. Firm will also do interior design for Grumman Gulfstream turboprop business transports distributed by Southwest Airmotive Corp. Southwest appointed Associated Radio Inc. to handle communications and electronics installations on Gulfstreams.

Class 4 Unlimited Airframe Repair certificate has been granted by CAA to L. B. Smith Aircraft Corp., Miami International Airport, as supplement to Air Agency Certificate 3642 already held by the firm.

Australian Aerial Agricultural Operators Assn. has been formed with Basil Brown, Air Farmers Associates, Tamworth, N.S.W., named first president.

Half-million dollar hangar, shops and service quarters are being erected by Air International, Inc., at Miami International Airport to expand airline maintenance business. Company expects to double business in first year facility is operating and triple it the second.

New distributor for IT&T Federal autopilot is Spartan Aircraft Co.'s Aviation Service Division, Tulsa, Okla.

Value of aircraft propellers and parts shipped in first half of 1958 totaled 594.3 million, with military accounting for $75.5 million. Military business increased 58% over value of shipment in first six months of 1957. Number of civilian propellers shipped in first half of 1958 totaled 7,484 units compared with 8,646 in first half of 1957.

City-suburban and inter-plant helicopter service in Delaware Valley area has been started by Keystone Helicopter Corp., Philadelphia, Pa.

Civil Aeronautics Administration moved general safety district office, which certifies aircraft in parts of New Jersey, Pennsylvania and Delaware, to North Philadelphia Airport, Pa., from Echelon Field, Haddonfield, N. J.

Multiple-unit T-hangars, capable of taking business planes through Cessna 310 category, have been installed at Sacramento and Stockton, Calif., municipal airports. Former has 36 units, latter 24 units. Pascoe hangars have 11 ft. 2 in. clearance, 39 ft. 6 in. frontal width and 20 ft. tail sections, are all metal.

Modified Lear F-5 autopilots, redesignated ASN-22, will be fitted to de Havilland-Canada DHC-4 Caribou and Beech L-23 Twin Bonanza under a $716,000 contract from U. S. Army Signal Corps. Production is expected to start March 1959, and follow-on orders are anticipated.

Dividend of 15 cents on Class A stock and one-and-one-half cents on Class B stock was voted by Edo Corp., College Point, N. Y., with payments scheduled Sept. 26.

Formal protest regarding adoption of Civil Air Regulation Draft Release 58-5 in its present form was made to Civil Aeronautics Board Safety Bureau by Dr. Leslie A. Bryan, chairman, General Aviation Facilities Planning Group. Draft release proposes that all airborne equipment used for IFR flight operations to be an approved type built to meet a CAA technical standard order. Bryan protested that such a ruling would render obsolete much equipment currently used by private fliers and add to cost of servicing equipment.

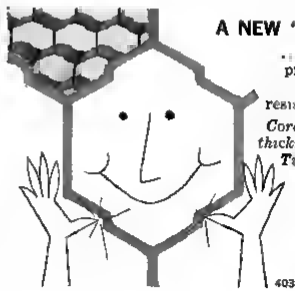
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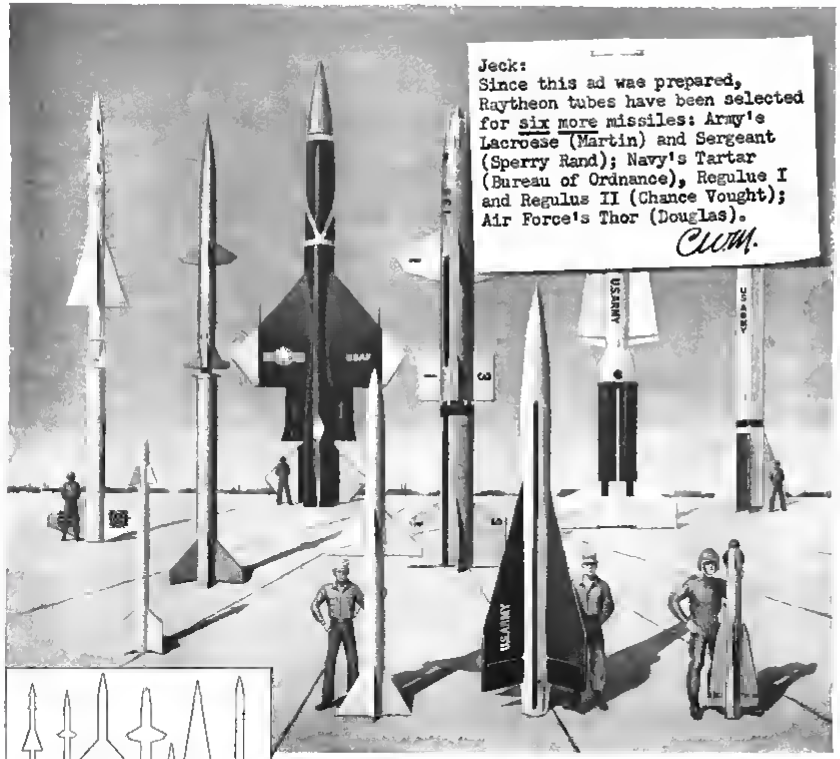
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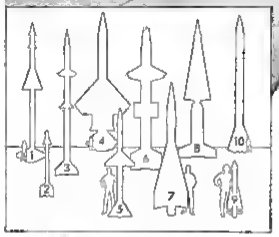
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2. Sidewinder. Navy Air-to-air. Prime contractors: Philco, General Electric
3. Terrier. Navy. Surface to-air. Prime contractor: Convair.
4. Bomarc. Air Force. Ground-to-air. Prime contractor: Boeing.
5. Sparrow III. Navy Air-to-air. Prime contractor: Raytheon
6. Talos. Navy Surface-to-air. Prime contractor: Bendix.
7. Hawk. Army and Marine Corps Ground-to-air. Prime contractor: Raytheon
8. Nike Hercules. Army Ground-to-air. Prime contractor: Western Electric
9. Falcon. Air Force. Air to-air. Prime contractor: Hughes Aircraft.
10. Corporal. Army Ground-to-ground. Prime contractors: Firestone, Gilfillen.

10 MAJOR U. S. MISSILES RELY ON RAYTHEON TUBES

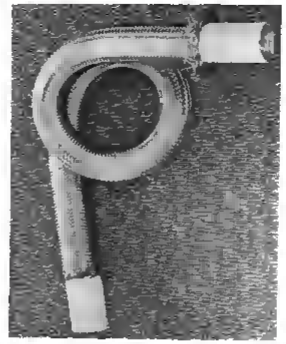
Crushing acceleration and searing heat must be endured by the electronic tubes in guided missiles. Even under these grueling conditions, tiny Raytheon tubes produce guidance impulses with steadfast *reliability*. This reliability is achieved through capable engineering and painstaking manufacturing and testing techniques.

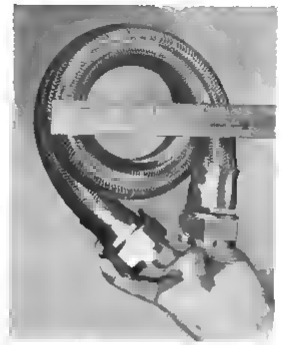
The choice of Raytheon Reliable subminiature tubes for use in these 10 missiles is another example of how the 31,000 men and women of Raytheon are contributing to the nation's security.

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CONVOLUTED Teflon inner core is exposed at left. Fabricated from Teflon and Fiberglas tape, the hose can be produced in continuous 25 ft lengths. Flexibility of completed hose assembly is demonstrated at right; minimum bend radius is 3½ times tube size

Teflon's Flexibility, Long Length Suggest Missile Fueling Application

New York—Flexible Teflon hose in diameters larger than one inch is being produced by Titeflex, Inc. as part of a sales campaign designed to restore the company's position in the field. Hose is being considered for use on the General Electric J93 chemical engine, the J79 and the J57.

Designated Springfield "400," the hose is one of several new products slated to be introduced by the management team installed one year ago by the Atlas Corp. which controls the Springfield, Mass. company. The company appears to be coming out of a business slump which had resulted in a deficit in 1956 and 1957.

Convoluted Inner Core

The new hose, which figures prominently in the company's plans, has a convoluted inner core. It is not extruded and can be produced in continuous 25 ft. lengths. Flexibility and long lengths suggest application for the convoluted hose in missile fueling and ground handling lines. Other applications for Springfield "400" hose include aircraft and missile high temperature fuel and oil lines and low pressure hydraulic systems. Flexibility of the convoluted hose reduces the necessity of pre-forming and minimizes possibility of damage during installation. If bent beyond the hose minimum bend radius (3½ times the equivalent tube size) the hose will flatten out but will return to its original shape after straightening.

Initially, the convoluted hose will be offered in size −24 (1½ in. diameter). Sizes −16 and −20 are in production but not currently available. Titeflex plans to market convoluted Teflon hose in sizes to 8 in. in diameter. Development and test of the larger sizes is now in progress, the company reports.

Rated pressures for Springfield "400" size −24 hose are given as 250 psi. operating, 500 psi proof and 1,000 psi burst. The company says that these ratings are rather conservative and that actual burst pressures have averaged 4,000 psi. Tests are continuing at the company in an effort to increase the pressure limitations.

Temperature qualifications for the new hose have been increased from 350 to 425F. Again, Titeflex says that it is running tests to raise the temperature limit. Low temperature limitation for all sizes of convoluted hose is given as −67F.

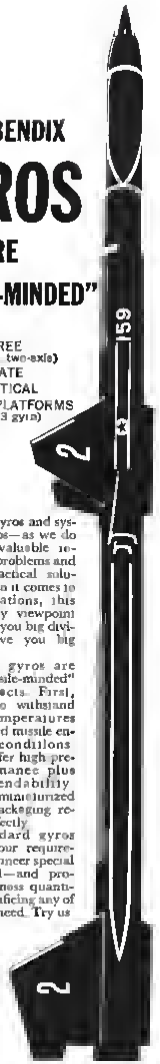
Cost Factor

Cost of Springfield "400" hose is said to run 25 to 30% higher than extruded Teflon hose. Titeflex, however, is quick to point out that some of this added expense can be regained by the use of shorter lengths of the flexible hose. The firm also states that costs probably will be reduced as production experience is gained.

Technique employed in the fabrication of the convoluted hose utilizes Teflon and Fiberglas tape. The Teflon Tape is helically wound on a mandrel and then overlaid with a Teflon coated

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John E. Gibbons, Vice President, King Fifth Wheel Co., tells . . .

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"But, we were running into trouble in the rolling operation. And rejects were raising cain with our delivery schedule. So we called in another supplier, General Electric – the original developer of René 41 vacuum-melted alloy.

"G.E. supplied us with material of consistently high quality. And, their engineers worked closely with us to help iron out fabrication problems. Today, thanks to the General Electric vacuum-melting service, we've cut rejects to a minimum . . . and we're making on-time deliveries of a top quality product."

Whatever vacuum-melted alloy your specifications call for, you too can profit from G.E.'s experience and technical know-how in the field of high-temperature alloys. For facts about G.E.'s vacuum-melting and engineering services, write: *Metallurgical Products Department of General Electric Company, 11107 E. 8 Mile Blvd., Detroit 32, Michigan.*

*Trademark of the General Electric Co.

Progress Is Our Most Important Product

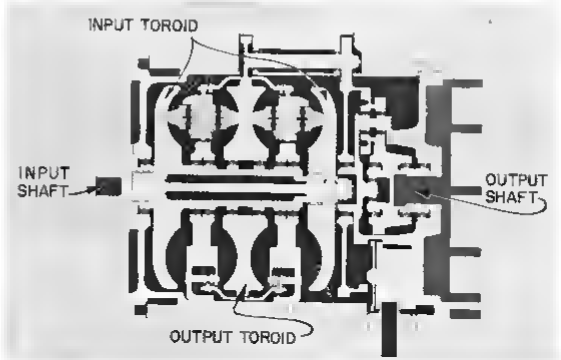
GENERAL ELECTRIC

fiberglas tape which adds resilience to the tube and tends to stop the seepage of fuels common with Teflon hose.

The Teflon and Fiberglas tube is then put through a die which convolutes and compresses the two layers of tape.

This is sintered into a homogeneous structure to complete the fabrication of the inner core. Titeflex states that the low convolutions in the hose create a minimum pressure drop as compared to convoluted metal hose. One unknown in the production of convoluted hose is the percentage of continuous 25 ft. lengths that can be produced. This is due to convoluting, sintering and braiding flaws which will cause portions of the hose to be cut out.

Following the fabrication of the Teflon inner core, the hose undergoes the overbraiding of stainless steel wire and swaging of fittings standard in the production of extruded hose. Titeflex says that standard end fittings will be available on the new hose with special configurations available at specific customer request.



CUTAWAY shows a Lycoming constant speed drive designed to operate at 600F. Lycoming has received a contract for development of the drive from North American Aviation, Inc.

Lycoming Constant Speed Drive Designed for Operation at 600F

New York—A prototype Lycoming 20 kva mechanical constant speed drive demonstrated ability to operate continuously above 300F during recently completed qualification tests.

Lycoming is a subcontractor to North American Aviation as part of an Air Force contract for development of an airborne electric generation and distribution system designed to operate at 600F ambient temperature. This would indicate use on the USAF B-70 Mach 3 bomber (AW July 14, p. 26).

Production models of Lycoming's 20 kva constant speed drive (AW Aug. 5, 1957, p. 87) are undergoing qualification tests and are expected to be completed during December. A 20 kva unit has accumulated a total of 2,000 hr. One drive completed seven hours of operation with 500F oil in temperatures of which two hours were over 600F. No failures of any parts occurred, Lycoming said.

Lycoming constant speed drive units have output planetary gearing to give steady outputs of 6,000 to 8,000 rpm. Input speed range is 2,300 to 8,500 rpm.

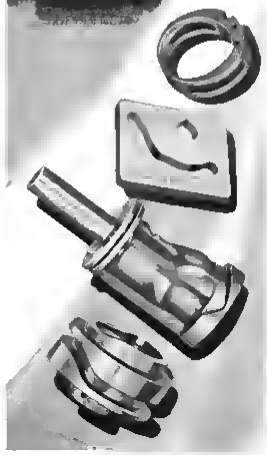
Chlorinated silicone fluid is used as a lubricating medium in the Lycoming drives.

An electronic device allows control frequency to be held within plus or minus ¼ cycle in a steady state operation. With a 100% load applied instantaneously, the alternator cycles vary a maximum of plus or minus six cycles and return to steady state within .6 sec., Lycoming said.

Other tests Lycoming has conducted on the drive include 125 hr. of 200% continuous loading; 40 hr. with shock loads, load transients, low frequency and automatic paralleling.

A transmission is scheduled for flight test in a Navy Lockheed P2V during October and a test of the production model on turbine engines is expected to begin later this year.

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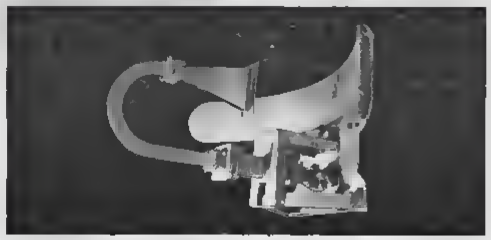
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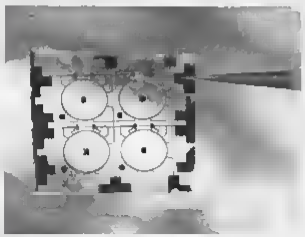
EONIC CAMS



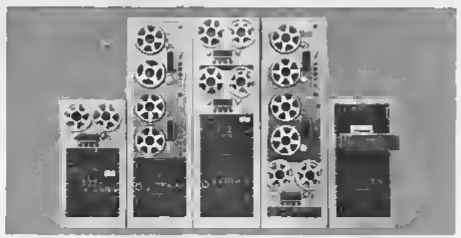
Horn fed parabolic reflector antenna for airborne applications



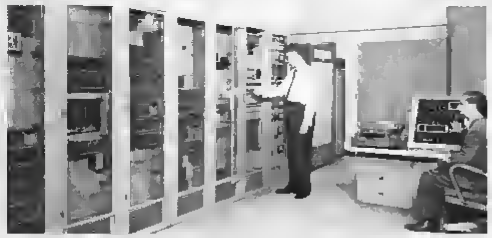
Charged aluminum particle suspended and controlled in a vacuum chamber by an oscillating electric field



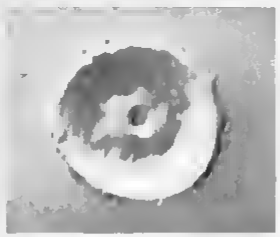
The Paraistor gives promise of cryogenic computer memories with a capacity of 1,000,000 bits per cubic foot and access times of 1/30 microsecond



Ground based data handling equipment for processing analog and digital reconnaissance information



Data conversion system for digitizing and processing telemetered missile test data.



Electron micrograph of impact produced on aluminum coated glass by a 1 micron diameter particle traveling at 7,000 feet per second

Pictorial **PROGRESS REPORT**

The photographs above illustrate some of the recent research, development, and manufacturing activities at Ramo-Wooldridge. Work is in progress on a wide variety of projects, and positions are available for scientists and engineers in the following fields.

Digital Computers and Control Systems
Communications and Navigation Systems
Guided Missile Research and Development
Infrared Systems
Electronic Countermeasures
Electronic Instrumentation and Test Equipment
Basic Electronic and Aeronautical Research

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P-1B Pilots to Use Liquid Oxygen System

London—Liquid oxygen breathing systems will be installed in English Electric P-1B Lightning, the first aircraft to carry the new breathing system. Later aircraft will include the Supermarine Scimitar, de Havilland Sea Vixen, Fairey Gannet and the Folland Gnat.

Switch from gaseous breathing equipment will be made by British Oxygen Arc Equipment Ltd. Gaseous equipment in current use requires two 750 liter oxygen cylinders weighing 35 lb. A single 3.5 liter liquid oxygen container provides twice the equivalent volume of oxygen with a weight of only 15 lb. and requires less space.

Polytechnic Institute Expands Curriculum

New York—Polytechnic Institute of Brooklyn now offers graduate engineering study courses at its Aerodynamic Laboratories in Freeport, N. Y. Previously, the institute presented a graduate curriculum at only one location, Mineola High School, Mineola, N. Y. With the two facilities, the combined program comprises 27 courses. The Aerodynamic Laboratory houses Polytechnic's hypersonic wind tunnel installation, capable of generating the test equivalent of wind forces in excess of 10,000 mph.



Life Raft Designed for Overwater Jetliners

Airline crew tests 25-man life raft slated for use on overseas jet flights. Raft is inflated in 9 sec. by two 200 cu. in. 3,000 psi. air bottles. Rubberized nylon raft is made by Goodyear Rubber Co.; inflation unit by Walter Kidde & Co.

ADC Evaluates Runway Arrestor

Air Defense Command has completed evaluation tests of All American Engineering Co.'s "water squeezer" arresting system at Sussex County Airport, Del. System, designed to prevent runway overshoots on takeoff and landing, employs an arresting hook fitted to the aircraft and a cable on the runway connected to energy absorbing pistons.

Two Northrop F-89 aircraft were used for the tests, which involved 19 arrested landings. The 35,000 lb. fighters were stopped by the system which is said to be capable of handling aircraft weighing from 14,000 to 54,000 lb. at speeds to 160 kt. Aircraft used in the test were from the 4750th Test Squadron of the ADC's 73rd Division at Tyndall AFB, Panama City, Fla.

HERE ARE A FEW EXAMPLES OF THE PROBLEMS WE ARE PREPARED TO SOLVE:

- ☐ Programming research in petroleum
- ☐ Traffic studies—origin and destination
- ☐ Report Making
- ☐ Liquid flow analysis
- ☐ Power utility distribution studies
- ☐ Computer simulation
- ☐ Cut and fill calculations for highway construction
- ☐ Engine design calculation
- ☐ Vibration analysis
- ☐ Military and management consultation and operations analysis
- ☐ Automatic structures design programming
- ☐ Mathematical or scientific equation and problem solving
- ☐ Product or organization simulation
- ☐ Other (please describe)

A complete range of General Electric Computing Services is now available to industry, business, education, military and government. Facilities include a large and versatile high capacity computer and a staff of 70 analysts, programmers, coders—leaders in the computer applications field.

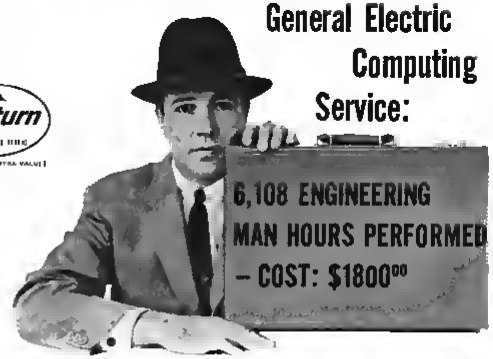
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Part of Rohr Aircraft's heat treating facilities where alloy steel flap tracks are put through a four-step cycle: (1) austenitizing (2) air quench (3) oil quench, (4) hot water rinse. Sequence maintains required dimensional stability.

ALLOY STEEL MEETS HIGH STRENGTH, PRECISION REQUIREMENTS IN USAF BOMBERS. Steel weldments produced by Rohr Aircraft Corporation, Chula Vista, California, are an excellent example of the aircraft industry's constant effort to develop better and more economical methods of mass producing large, high-strength structural aircraft components.

Rohr is currently using this weldment technique in manufacturing flap tracks for an Air Force bomber. The flap tracks are fabricated from AMS 6428 Alloy Steel, a type supplied by Republic. This fine steel provides a minimum tensile strength of 180,000 psi in the heat treated condition. Uniform response to heat treatment assures exceptionally good deep hardening characteristics—plus hard, wear-resistant surfaces.

The exceptionally high strength-to-weight ratio of Republic Alloy Steel combined with the highest strength values permits the design of thinner, lighter track sections to save weight and hold down size without sacrifice of strength or safety.

Rohr's development of specialized tooling, welding, and heat treating techniques permits the production of these alloy steel weldments to close tolerances—a rigid aircraft engineering requirement. Costs are reduced by eliminating the need for expensive equipment and excess stock removal.

Specify Republic Alloy Steel for your parts that must be tough, strong, dependable. Our metallurgists are always available to help you in selection and processing. The coupon is your invitation to use this obligation-free service.



REPUBLIC STAINLESS STEEL. Type 302, cuts costs, saves weight, resists corrosion in jet aircraft storage battery cases made by Sonotone Corporation, Elmsford, New York. Stainless steel's exceptionally high strength to-weight ratio and ability to withstand impact and vibration permits the use of a lighter gage, thus saving weight. Sonotone reports the metal's outstanding corrosion-resistance eliminates the need for painting the cases with no detrimental effect on service or appearance. Republic Stainless Steel also resists the wide extremes of temperature and atmosphere through which the batteries must operate. Mail the coupon for more facts on Republic ENDURO® Stainless Steel.



REPUBLIC'S NEW HIGH STRENGTH POWDER, TYPE 6460, opens the way for sintered parts for highly stressed parts in aircraft and missiles. Type 6460 can be used with existing operating equipment. It provides a minimum tensile strength of 60,000 psi at 6.4 density as sintered, and 100,000 psi heat treated. Type 6460 maintains its dimensional characteristics after sintering—less than .004 inches per inch shrinkage from die size at 6.4 density. Available in production quantities up to and including 12 tons, or multiples thereof. Mail coupon for technical data sheet on Type 6460 Powder.

REPUBLIC TITANIUM ALLOYS are used for weight saving and elevated temperature applications in the B-58 Hustler. The supersonic bomber is built for the Air Force by Convair, a division of General Dynamics Corporation, Fort Worth, Texas. These particular titanium alloys have minimum tensile strength of 130,000 psi and a minimum yield strength of 120,000 psi. Among the strongest alloys now being produced, they meet the demand for high strength to resist the effects of aerodynamic heating in supersonic aircraft, such as the B-58. Republic metallurgists and engineers, pioneers in the development of high strength to-weight metals, are ready to help you apply titanium to your product or process.



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T/I 'electronic escorts' bring all-weather travelers safely home

Soon now, TI-built and TI-modernized airport surveillance radars will meet air travelers far outside congested airport areas and escort them electronically to an ideal approach fix. The Civil Aeronautics Administration has already ordered this potent safety factor for more than *seven* dozen major U. S. airports. Able to keep tabs on large numbers of aircraft operating in airport approaches (up to 60 miles distant), TI radars will log all aerial moving objects over video maps pinpointing navigational aids and hazards. In "ducks only" weather, the traffic controller can switch from linear to circular polarization for a clear look through clouds and precipitation.

Close kin to Texas Instruments military and industrial electronics, TI airways radar benefits from the most advanced technologies practiced today. Details on this new aspect of TI's 28-year-old capabilities may be obtained by writing to: Service Engineering Department . . .

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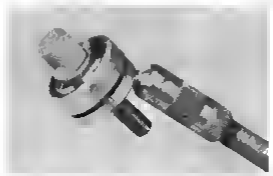
High strength alloy sheet steel for missiles and space vehicles has a tensile strength level in the 280,000 psi range, the maker states. Material may be fabricated with welding, heat treating and hydrospinning techniques.

Airsteel X 200 alloy develops its strength by a heat treating and air cooling process which eliminates the necessity for oil or salt quenches. Produced in the annealed condition, steel is fabricated into missile components before heat treatment. Alloy is available in billets, blooms, bars, plates and sheets.

United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.

Airframn Bnaring Grnasnr

Airframe grease attachments are designed to fit into limited space and serve as a grease fitting for sealed airframe bearings. Attachments fit K3A, K4A,



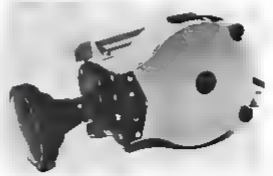
K5A, K6A, KL3, K3, K4, K5, K6, K3L, KS3, KS4, KS5 and KS6 size bearings. Any size may be obtained on special order.

Monarch Aircraft Sales, Inc., 3311 E Gage Ave., Huntington Park, Calif.

Drone Instrnmentation Camera

Airborne instrumentation camera, in use on the Q-2A Ryan Firebee jet drone, is said to be reliable at high speeds and low temperatures. Camera is designed to shoot 200 frames per second and hold 200 ft of 16mm film on daylight loading spools.

Model 560 Fotomatic meets Mil Spec 5257A and withstands acceleration to 25Gs. Continuous or intermittent operation is provided by a 28 volt



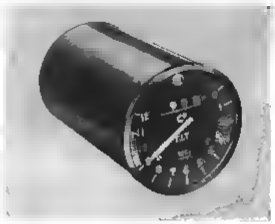


Craig Designs Portable Shelter

Helicopter-transportable communications center shelter that can carry up to 2,500 lb. of electronic equipment has been developed by Craig Systems, Inc., Lawrence, Mass. Unit weighs 350 lb and has lightweight aluminum-faced panels. Cores of poured-in-place foam are bonded together with epoxy resin to form structure, there is no welding or riveting. Dimensions are 70 in. long, 54 in. wide and 56 in. high.

d e motor. Shutter opening of 73 deg provides exposure speed of 1/1,000 sec at 200 frames per second. Accessories include boresights, tracking finder and various 16mm. lenses. Timing system, output pulse installation, positive viewfinder with three-objective turret and shutters from 7 to 204 deg. are also optional. Over-all dimensions are 8 in. x 5⅞ in. x 6¼ in., weight is 6¾ lb.

Trad Corp., 17136 Ventura Blvd., Encino, Calif.



Jet Tempnrature Gage

Transistorized, servo-driven potentiometric indicator for jet engine turbine inlet temperature and exhaust gas temperature is designed for commercial and military jet aircraft. Indicator has both a needle pointer and a servo drive counter type digital readout.

Model BH183 Autotemp gage measures gas temperature through the electromotive force output of a chromel-alumel thermocouple harness in the engine. Range of the unit is from 0 to 1,200C; accuracy is + or — 1 deg in the 500 to 1,000C range. Gage is completely self-contained in a 3 in. diameter, 7 in. long case, which weighs 1.75 lb. Over temperature warning light is provided.

B & H Instrument Co., Inc., Fort Worth, Tex.

Engine Warmnr Disk

Engine warmer disk, incorporating a Fiberglas-polyester plastic ring fitted with a canvas cover, is said to simplify external warming of reciprocating engines in cold weather.

The canvas disk fits tightly into a



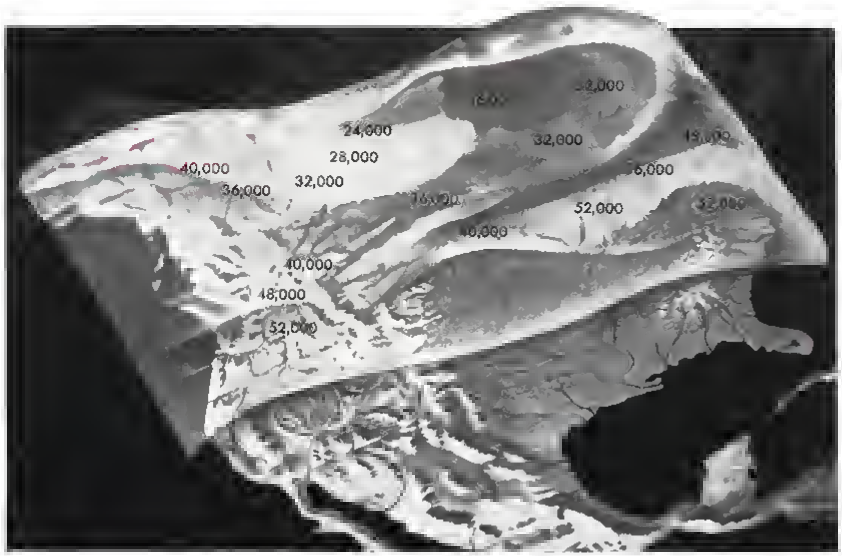
FLY WEATHER-WISE — Mobil

These weather items prepared in consultation with the United States Weather Bureau

THE TROPOPAUSE

With the introduction of turbo prop and turbo-jet aircraft the location of the tropopause assumes greater importance. Technically, the tropopause is that point in the atmosphere where the normal decrease of temperature with altitude ceases. It is the coldest layer in the atmosphere encountered by turbine-powered aircraft. It also indicates the level of maximum winds which are always found within a few thousand feet of this tropopause layer.

As the illustration shows, the height of the tropopause varies across the United States from 30,000 ft. to 56,000 ft. In some places it slopes down almost vertically, especially over the cold side of jet streams. Notice when flying from North to South, the average range of the tropopause varies almost 100% and temperatures vary sharply under such flight conditions.



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circular engine nacelle to retain warm air that is fed to the engine.

Peterson Products, 1751 Leslie St., San Mateo, Calif.

WHAT'S NEW

Reports Available:

Artificial Satellites (Iskusstvennyye Sputniki)—By A. Shternfeld—Pub. State Publishing House of Technical Theoretical Literature, Moscow, 1958. Book was translated into 433 pages by the Technical Documents Liaison Office, Wright-Patterson Air Force Base, Ohio, and may be purchased from OTS, U. S. Department of Commerce, Washington 25, D. C., for $6.00.

List of Soviet Nuclear Research—A list of more than 100 titles representing the latest Soviet research in atomic energy is free of charge from Document Service, Department R, The Chronicle of United Nations Activities, 234 West 26th St., New York 1, N. Y.

Table of Transport Integrals—By William M. Rogers and Robert L. Powell. National Bureau of Standards Circular 595, issued July 3, 1958, $.40. Order from, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

High Temperature Resistant Sealant Materials—by L. C. Boller, G. M. Le Fave, E. O'Brien, A. Milner and J. H. Emrgh, Coast Pro-Seal and Manufacturing Co. for Wright Air Development Center, U. S. Air Force, September, 1957. $.75, 26pp., (PB 131478)

Design Data For O-Rings and Similar Elastic Seals—C. E. Trepus, Boeing Airplane Co. for Wright Air Development Center, U. S. Air Force. September, 1957. $3.00; 114pp. (PB 131510)

Human Engineering Bibliography, 1955-1956—by E. V. Saul and others, Tufts University for Office of Naval Research. October, 1957. $4.75, 326pp., (PB 131507).

Register of Planned Mobilization Producers—by Assistant Secretary of Defense (Supply & Logistics). $1.00.

Human Factors Considerations in the Design Proposals for a Ballistic Missile Unit Proficiency System—by F. F. Kopstein and R. L. Morgan, Wright Air Development Center, U. S. Air Force. December, 1957. $.50, 17pp., (PB 131696).

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INFORMATION THEORY ANALYST—Experienced in mathematical analysis of mechanical and electromagnetic transmission of information.

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APPLIED MATHEMATICIAN—Experience in logical programming of systems and interest in communication and probability theory.

Your complete resume should contain personal, educational, experience data, and salary requirements. Send to DIRECTOR OF PLACEMENT. All replies will be held in strict confidence.

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AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts as released by the Air Materiel Command, Wright-Patterson AFB, Ohio.

Continental Aviation and Engineering Corp., Detroit, Mich., J69-T-9 engines for T-37A aircraft and engineering and maintenance data. (FPR PF-6-C2A-6025) $2,913,764

Chicago Aerial Industries, Inc., Melrose Park, Ill., automatic V/R sensing (PR 12584) $79,840

Kendall Co., Inc., Clifton, N. J., amplifiers, spare parts, special tools, test equipment for support of the F-104A aircraft program. (FPR PES-8-6X-24731) $134,313.

Electric Welding and Engineering Corp., Milwaukee, Wis., photographic tanks and ground support equipment. (FR MO 8-6740-1344) $60,616.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, type MD-1 vertical gyro and type MC-1 rate gyro for installation on F-105B, D, E; KC-135A, Battle, F-100F, T-33A, A-37A and YT-38 aircraft. (FR PE-8-6SC-3-08 and MA-8-6SC-1085) $1,783,693.

Mosse Instrument Co., Hudson, Ohio, spare parts for F-1 pointer and ground support equipment. (FPR MO 8-6740-1357) $3,949.

AiResearch Manufacturing Co., Division, The Garrett Corp., Los Angeles, Calif., actuators (supply). (FR SA-8-63C1-4637) $83,370.

Kenefell Co., Inc., Clifton, N. J., indicator type V-1A, for support of various Army aircraft. (MIPR R 63-857052-CS-01-25). $52,840.

Leac, Inc., Grand Rapids, Mich., actuators (supply). (FR SA-8-63C1-4668), $59,267.

Collins Radio Co., Cedar Rapids, Iowa, indicator, horizontal situation, type AF/A34J-1 for F-100A, F-100F and F-1[illegible]E aircraft. (FR PE-8-6SC-3634), $978,44a.

AiResearch Manufacturing Co., Division, The Garrett Corp., Los Angeles, Calif., actuators (supply). (FR SA-8-63C1-4630, 4640 and 4680), $312,239.

Graflex, Inc., camera set KS-8 and related spare parts and data and ground support equipment. (MIPR R62 89(10)2-SC-01-25), $305,762.

General Electric Co., Erie, Pa., generators, 35v. d.c. type MA-8, adapters, accessory mounting 6° Quad, including engineering, maintenance, [illegible] and data, for C-124 aircraft. (FR SA-8-63C-4741), $132,757.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., wheel assembly, landing gear, for B-60 aircraft. (FR 60-8-63B-1857) $405,236.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., wheel and brake assemblies for C-130B, C and F; SA-15A and B; main wheel assemblies for F-86A, D, E, F, K and L and F-100A and C aircraft. (FR 60-8-63B-1847, 1700, 1532, 1545 and 1784), $1,000,990.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., brake assemblies for F-86 aircraft; wheel assemblies for F-102 aircraft; wheel brake and axle assemblies for C-123A aircraft. (FR 60-8-63B-1814 and 1716 and PE-8-63B-3472), $1,073,275.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Air Force Contracting Offices.

HEADQUARTERS, AFFTC, ARDC, USAF, Edwards AFB, Calif.

Shakel Engineering & Supply Co., Glendale, Calif., helium booster compressor, AF 5100-NL, 1 ea., $10,860.

Cook Research Laboratories Division, Cook Electric Co., Chicago, Ill., engineering study, 1 ea., $84,812.

Eastman Kodak Co., Rochester, N. Y., paper processing machines, AF 1400-NL, 1 ea., $23,436.

Mullenpenk Optical Co., Rochester, N. Y., 35 mm high speed motion picture camera, AF 5100-NL, quantity 1 ea., $17,450.

Digitronics, Inc., Los Angeles, Calif., photographic timing and control system, AF 595-NL, 1 ea., $30,545.

Motorola, Inc., Riverside, Calif., development of an operational portatype remote data acquisition and transmission system, 1 ea., $100,787.

Physicum Pacific, Los Angeles, Calif., pericalorimeter, AF 5005-NL, 38 ea., FTKL-58-6[illegible], $37,058.

Cook Electric Co., Chicago, Ill., development of monorail water brake vehicle, 1 ea., $78,392.

Motorola, Inc., Chicago, Ill., microwave data transmission system, AF 5980-NL, 1 ea., $61,423.

Electronic Associates, Inc., Long Branch, N. J., computer pipline system, AF 1800-NL, 1 ea., $38,948.

Shavid Engineering, Inc., Plainfield, N. J., development of a central telemetry facility, AF 1740-NL, 1 ea., $360,000.

Cook Research Laboratories, Division, Cook Electric Co., Chicago, Ill., additional requirements and complete funding of supersonic [illegible] vehicle, 1 ea., $18,193.

Master Pest Control, Inc., Los Angeles, Calif., non personal services for insect and rodent control, 1 ea., (IFB 00-621-58-247), $25,150.

HEADQUARTERS, AIR FORCE CAMBRIDGE RESEARCH CENTER, ARDC, USAF, Laurence G. Hanscom Field, Bedford, Mass.

The Packard-Finee Corp., Norwalk, Conn., optical system [to be incorporated in satellite tracking camera]. (RFP 6-075 and 0567-A1, AF19[604]-4350, $98,500.

Buller and Chirone, Inc., and Joseph Nunn and Associates, South Pasadena, Calif., satellite tracking camera. (RFP 58-701, AF19[604]-4360, $185,000.

Aerojet-General Corp., Azusa, Calif., studies, testing and services in connection with rockets. (RFP 05008), AF19(604)-4094, $112,861.

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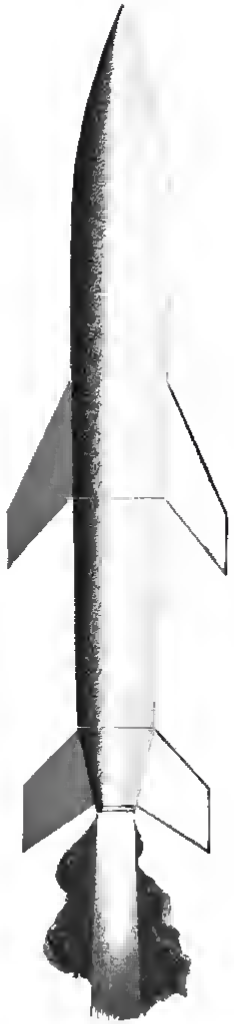
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WHO'S WHERE

(Continued from page 23)

Changes

E. T. Walton, manager-customer technical services and James A. Kearney, manager-materials and processes, Metallurgy Division Technology Department, Crucible Steel Company of America, Pittsburgh, Pa.

Clary Dynamics Division of Clary Corp., San Gabriel, Calif., has appointed James P. Hobstetter industrial representative for Wright-Patterson AFB, Shelby AFB and Gentile AFB with headquarters in Dayton, Ohio.

John K. Broback, assistant manager export sales, Boeing Airplane Co.'s Transport Division, Seattle, Wash.

Robert J. Stanbury, assistant to the manager, Electronic Systems Division, Dalmo Victor Co., Belmont, Calif.

Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., has announced the following appointments: John Craig, Jr., chief military and commercial sales; Henry J. Remmer, chief field engineering; Donald S. Conrad, chief sales operations; Stanley M. Taylor, chief, commercial sales.

Richard M. Whitehorn, manager radiation research, Radiation Division, Varian Associates, Palo Alto, Calif.

Dr. Bruce P. Bogert, head, Acoustic Department, Research Laboratories Division, Bendix Aviation Corp., Southfield, Mich.

Anthony Kreslik, rotating equipment project engineer, Pesco Products Division, Borg-Warner Corp., Burbank, Calif.

Dr. Daniel C. Schiavone has returned to the Rockets Division, Bell Aircraft Corp., Buffalo, N. Y.

Benjamin S. Yaffee, technical service engineer, Defense Products Department, Calery Chemical Co., Pittsburgh, Pa.

Hayden N. Ringer, manager-newly established advanced weapon systems (AWS) group, Government and Industrial Division, Philco Corp., Philadelphia, Pa.

George W. Carson, project engineer, Kaman Aircraft Corp., Bloomfield, Conn.

James S. Rice, manager-manufacturing methods, Rohr Aircraft Corp., Chula Vista, Calif.

Austin Marquis, manager-contracts and commercial sales, Stanley Aviation Corp., Denver, Colo.

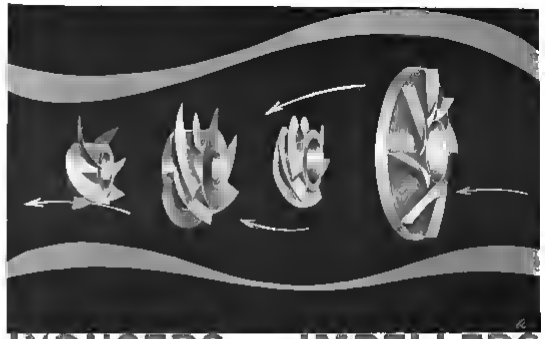
Henry B. Nelson, Jr., eastern district manager (Stamford, Conn.), Sundstrand Aviation division of Sundstrand Machine Tool Co., Rockford, Ill.

Kenneth R. Waltz, chief engineer, George L. Nankervis Co., Detroit, Mich.

Donald R. Freer, representative in charge of field service at Patrick AFB, Fla., for Rocketdyne division of North American Aviation, Inc., Canoga Park, Calif. Mr. Freer succeeds Wesley E. Bevan, who has returned to Rocketdyne headquarters.

Jerome R. Steen, engineering reliability specialist, Ballistic Missile Early Warning System program, Sylvania Electronic Systems division of Sylvania Electric Products, Inc., Waltham, Mass.

Frederick P. Huston, chief methods engineer, and Scott N. Randall, chief product



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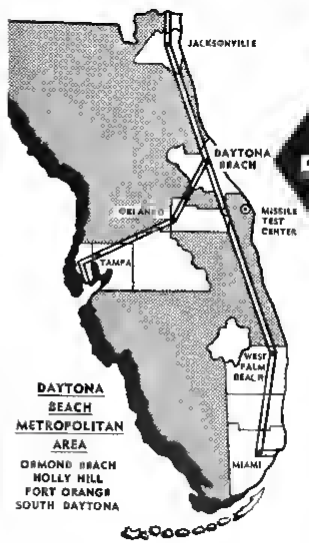
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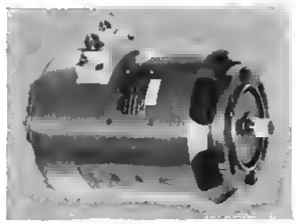
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engineer, Tube Reducing Corp., Wallington, N. J.

V. V. Schlosser, manager of engineering, atomic equipment department, Westinghouse Electric Corp., Cheswick, Pa.

J. P. Brown, general manager, Astronics Division, Lear, Inc., Santa Monica, Calif. **Robert N. Nielsen** succeeds Mr. Brown as manager, West Coast area contracts office (Santa Monica, Calif.); Lear's Grand Rapids Division. **R. V. Paolucci** succeeds Mr. Nielsen as contracts marketing manager, Grand Rapids Division, Grand Rapids, Mich.

Frank Mansur, military sales representative-electronics, Lockheed Missile Systems Division, Sunnyvale, Calif.

Hans M. Schiff, operations manager, Ryan Aeronautical Co.'s Electronics Division, Torrance, Calif.

Philip de Benedon, planning director, Pacific Automation Products, Inc., Glendale, Calif.

Kenneth D. Davis, domestic and international sales manager, Kaylock Division, Kaynar Mfg. Co., Inc., Rivera, Calif. Also **Robert H. Randall**, general manager, Kaylock Division.

D. C. Duncan, corporate director of contract sales, Beckman Instruments, Inc., Fullerton, Calif. Mr. Duncan formerly was general manager of the Helipot Division. **D. C. McNeely** is now acting manager of the division.

Fred Hodge, liaison engineer, Horkey-Moore Associates, Torrance, Calif.

Andrew Shiland, Jr., general manager, United States, TSA Transcontinental Airlines of Argentina. Also **Don L. Urquhart**, North American sales manager.

John A. Bilka, factory manager, Communications Division, Topp Industries, Inc., Beverly Hills, Calif.

Charles Vickery, manager, Los Angeles marketing office, Defense Products Division, Fairchild Camera and Instrument Corp., Syosset, N. Y.

Brig. Gen. Richard D. Meyer, Deputy Chief of Transportation for Aviation, Office of the Chief of Transportation, Washington, D. C.

Ray Rhodes, chief engineer, Electro-Mechanical Specialties Co., Inc., Los Angeles, Calif.

Robert B. Kimnach, assistant to the president in charge of sales, Helio Aircraft Corp., Norwood, Mass.

Charles J. Wiley, market development manager, Callery Chemical Co., Pittsburgh, Pa. Also **A. J. Toering**, manager, Callery's Defense Products Department.

H. C. Emerson, general superintendent, production, Ruhr Aircraft Corp., Chula Vista, Calif.

Edward J. Messinger, senior systems engineer, Weapon System Support Project, Aerophysics Development Corp., subsidiary of Curtiss-Wright Corp., Santa Barbara, Calif.

Richard E. Stockwell, director of public relations and advertising, Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio.

John Schwinn, assistant to the president, Aeronca Manufacturing Corp., Middletown, Ohio. Also **W. Warren Whittle**, general manager, Aeronca's Baltimore Division.

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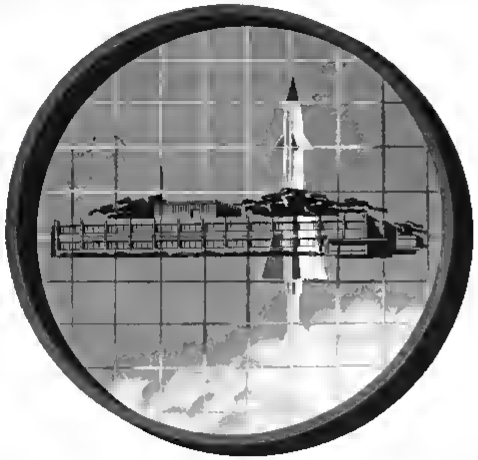
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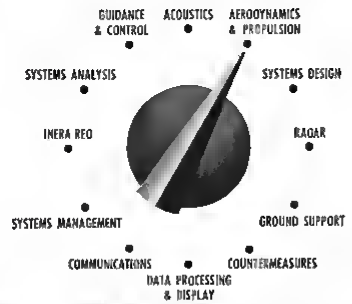
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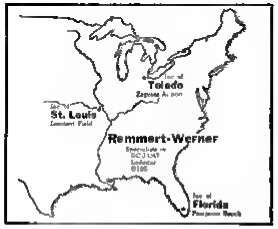
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LETTERS

Vertol Diversification

We are most interested in your roundup story on the helicopter industry which appeared in the Sept. 1 issue of AVIATION WEEK under the title "Fewer May Share Helicopter's Future." However, a contradictory and erroneous statement attributed to me, was made with reference to Vertol's diversification program.

The sentence reads, "... Vertol is not making a major effort to diversify outside the helicopter field but the company is putting money into design studies on missile handling equipment and research on radar tracking equipment." This statement in itself is contradictory and only could come from a misunderstanding. However, it has led a number of people to question our interest in diversification.

To clarify this position, I would like to point out that Vertol Aircraft Corporation is making a major effort to diversify outside the helicopter field as part of a long range corporate program. With the gradual development of this diversification program, we predict that by 1962 approximately 20 to 30% of our business will be in a carefully-selected general products or subcontract area.

Since June 1957 when we first announced the formation of a general products department, we have been actively seeking new business that would use our highly specialized manufacturing skills and engineering experience. During the past year, although the principal portion of company-funded projects has been helicopter developments, we have devoted time and funds to developing special processes and new materials. In addition, early this year we acquired Allied Research Associates, Inc., a well established research engineering firm, holding government contracts in advanced weapons fields. This acquisition has enabled Vertol and Allied to plan several projects that hold promise for new production outside of the helicopter field.

Because of the importance this diversification has in our present and future corporate planning, I believe our position should be clarified.

DON R. BERLIN
President
Vertol Aircraft Corporation
Morton, Pennsylvania

(By "major effort" AVIATION WEEK meant that the helicopter would continue to be Vertol's principal interest. It was not intended to underemphasize Vertol's efforts at diversification—*Ed.*)

Safety Is Goal

Your Aug. 18 issue contained an irrational outburst of the type one might get from an emotional child. It most certainly was not what one would expect to come from the pen of a professional aviator.

In his letter (p. 118), Navy Lieutenant made some very serious and, I feel, irresponsible allegations concerning airline pilots. I will not become embroiled in a point-by-point refutation of his arguments. Rather, I will merely point out one example of his provincial reasoning in approaching a very complex problem.

Despite the fact that he was flying from the rear seat, the good lieutenant probably had better overall visibility (except during takeoff and landing) than that afforded by the average airliner. This for the reason that he could "clear" himself below with a steep "S" turn and above by looking up before executing any maneuvers. Neither method is practicable in "T" aircraft.

Most mid-air collisions involved aircraft which were being flown in a generally straight line along parallel or nearly parallel courses. Now, a pilot making a practice jet penetration or approach cannot see through the floor of his aircraft any more than a transport pilot can see through the overhead of his.

In a word, that conveniently placed window referred to by Navy Lieutenant affords a painfully inadequate view of the three-dimensional medium in which we work. So "see and be seen" may be all we have at present, but it is certainly not the complete answer.

Any sincere attempt at resolving the problem should be given full consideration even if the proposed solution is itself inadequate at least it represents a constructive step in the right direction. Arbitrarily rejecting or tearing down another's ideas is as destructive as it is easy because no originality of thought is involved. We could go round and round on this, but I fear it would do nothing toward solving this problem which concerns all of us.

Although an airline pilot, I am also currently flying jet aircraft in the USMC Reserve. In addition I know a great many private operators and pilots. This background I thought afforded me a reasonably good view of the problem from the standpoints of both military and civilian pilots. However, if Navy Lieutenant represents the consensus of thinking among active duty military pilots, then something should be done to effect a closer relationship among the various groups, including the CAA, military, transport (both airline and executive) and people. I am sure my interested parties will find their nearest CAA Safety Office will be only too happy to assist in bringing this about.

Apology for or defense of any of the groups mentioned is unnecessary, because the integrity of each is well established despite isolated instances to the contrary. So let's call a halt to this useless name calling and the animosities it creates, and all get together in a spirit befitting our profession and work toward our common goal—air safety.

W. R. WILSON
Capt., TWA
Maj., USMCR
Novato, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Tarnished Brass

By policy directives dated Jan. 30 and Feb. 19, 1958, issued by the Chief, Air Force Museum Program, the Pentagon, 1,250,000 aircraft documents on file in the Air Force Central Museum at Wright-Patterson AFB will be disposed of in accordance with these directives.

The disposal authorizes the destruction of documents screening, briefing, etc., so that the major portion of retained materials will only cover information on exhibits on display at the USAF Museum. The balance of the priceless documents will be destroyed after briefs have been made, or stored in the dusty files of the USAF Records Center, St. Louis, Mo.

The one remaining source of historical reference material will thus have been disposed of. It will be well nigh impossible for students of aeronautical history, writers, researchers, engineers and technicians to ever have access to those that remain, and those that are destroyed will constitute a priceless loss. Our one remaining document center that loans material to approved persons will not function. Student engineers who must design the aircraft of the future will have no backlog of historical data to use for study and information to broaden their knowledge. If we do not know what has gone on in the past, how can we design and plan for the future of our airpower?

It is difficult for the writer to understand how the Joint Chiefs of Staff can populate the Pentagon with tarnished brass of such inept capability. If this is an example of the decisions that emanate from the Pentagon, Lord help America if we are ever attacked in a nuclear war!

Although these directives were issued the first part of this year, no action was taken until the present director had retired. This officer who took no action on this deliberate destruction of public domain should be commended. His successor, who admits that he wrote the order for this deliberate destruction, should be the object of concentrated criticism for exhibiting his lack of knowledge of what the heritage of airpower means to American people.

The wanton destruction of this material if carried out will again demonstrate that our freedom in America is further being restricted. The writer, along with other citizens, has contributed some elements of early aeronautica to fill out the Museum files.

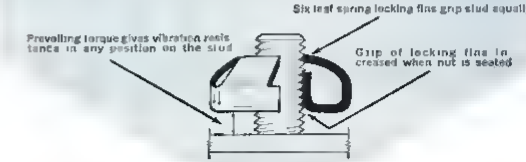
I believe the taxpayers have a vested right to this material and for higher authority in the USAF to condone and approve this destruction borders on the extreme limits of crass ignorance of the great interest shown in historical data on file in that museum.

What I stated previously in a letter to your magazine (Feb. 3, p. 118), that all of the shrunken heads are not to be found in the jungles of the Amazon, still appears to hold true!

WILLIS L. NYE, DIRECTOR
American Aviation Historical Society
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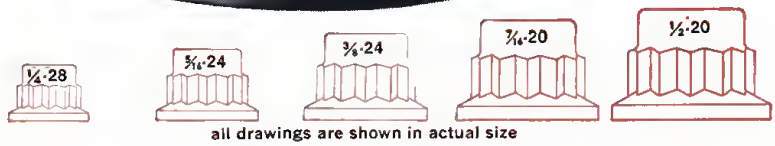
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Design refinements embodied in the LH3393 series consistently develop the full fatigue strength of 220,000 psi high strength bolts . . . yet these nuts are from 10% to 33% lighter, size for size, than even the lightest 180,000 psi locknut.

Additional weight savings are made possible by the smaller envelope dimensions of these new parts, since reduction of wrench clearance requirements permits reductions in the size of other structural components.

LH3393 series nuts are cold-formed from alloy steel, processed with the manufacturing skills and protected by the rigid quality control established during ESNA's 30 years of experience in supplying dependable aircraft quality fasteners. The same military approved, elliptically offset locking device used on ESNA's complete line of NAS parts, assures reliable vibration proof self-locking performance at temperatures up to 550°F.

For specific dimensional, design and test data on ESNA's *new*, lightweight, 220,000 psi nut—Type LH3393, write to Dept. S23-925, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey.

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